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Journal of Occupational Medicine

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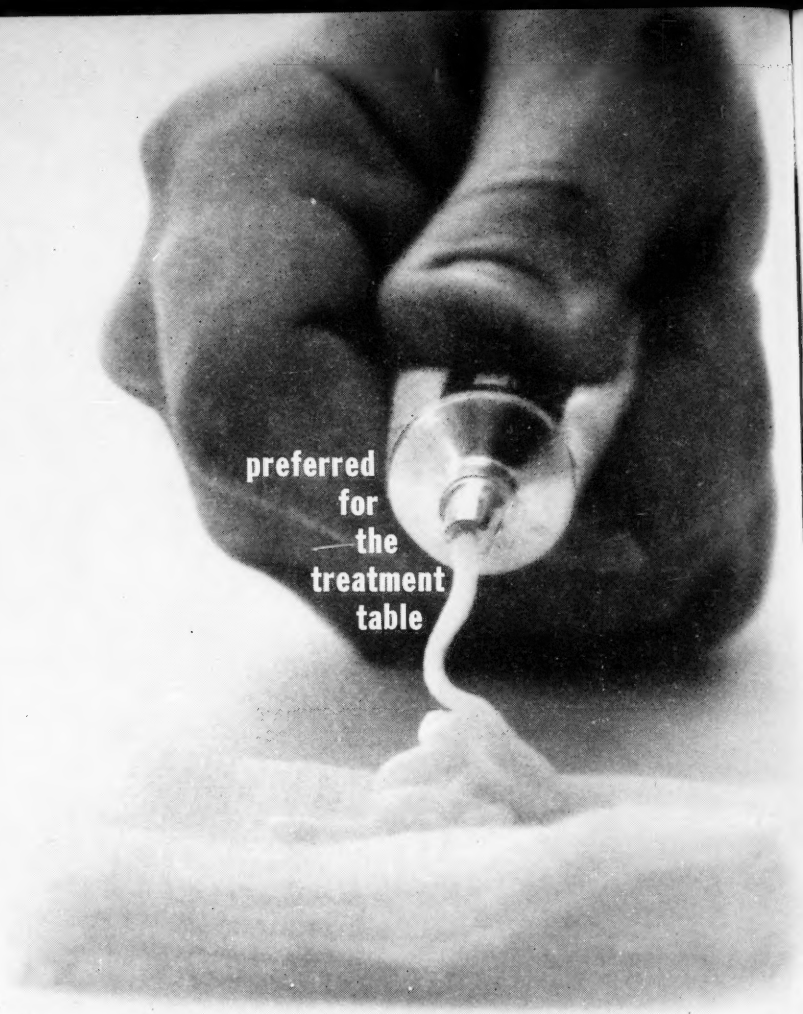

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Journal of Occupational Medicine

Dilemmas of the Occupational Physician in Mental Health Programming — Part I

Kenneth J. Munden, M.D., Topeka, Kan.

FOR THE PAST four years the Division of Industrial Mental Health of The Menninger Foundation has conducted an annual seminar in psychiatry for occupational physicians. From the discussions between seminar participants and the staff, certain dilemmas and problems in the application of psychiatric knowledge by occupational physicians have become apparent.

Dr. Levinson and I have divided the dilemmas into two kinds: those which confront any physician, about which I will comment, and those which confront the occupational physician in particular, which he will discuss. We are indebted to Drs. Howard V. Perlmutter and Paul Pruyser for their observations as discussion leaders in the 1959 seminar, which are incorporated in our presentations. We are also indebted to the 80 occupational physicians who have participated in our seminars and from whom we have learned about these problems. Dr. L. Holland Whitney, was a seminar participant in the 1959 seminar. He will discuss our presentations.

The thoughtful consideration of mental health problems by any physician ultimately brings him to the task of understanding and accepting certain general psychological principles. This is a major task, and it is not an easy one. In it he confronts his first dilemma, that of how to use himself in his professional role.

Dr. Munden is Psychiatrist, Division of Industrial Mental Health, The Menninger Foundation.

Presented at the Forty-Fourth Annual Meeting of the Industrial Medical Association, Chicago, Ill., April 29, 1959.

The Dilemma of Role

By tradition, a physician's training has ingrained into his professional life a very definite way of applying the healing skills that he has acquired. He seeks to find in the patient a specific illness for which there are specific remedies and treatments. He relies on certain techniques, and he deals with certain pathogens, whatever their nature. He is accustomed to proceeding in an orderly fashion, whether it be in the physical examination or in writing his orders. Instead of all this, the physician *has to use himself* as a therapeutic device in dealing with emotionally troubled patients. The patient's approach is the same—*asking for something*—and he expects to *get something* in return from seeing the physician. For his part, the physician *expects to be asked for something* and *to do something* about the patient's request. He is faced with the traditional medical problems: *I must do something* and *What can I do?* The questions, expectations and problems are the same, but the physician's response to them is different.

In dealing with emotional aspects of medical problems, the physician cannot escape the significance of the relationship between himself and the patient. If the relationship is so significant, the physician is required to be aware of himself and his impact on that relationship. Recognition of his involvement in a very important relationship to the patient, and the demands for awareness of himself arouse his anxiety. Looking at himself inevitably brings to the physician's awareness some of his own conflicts. He will be strongly tempted to deny

the importance of the relationship with his patient and to bury his head in the sand of procedures and prescriptions because of his discomfort. Under such pressure, he will feel, more than ever, that he wants simple, specific answers that will solve mental health problems. He will wish for pills and remedies. He will hope for tranquilizers that cure. He will seek anything, in fact, that can be prescribed impersonally to avoid the implications of a powerful and indispensable relationship. He seems to feel his choice is between using himself and his psychological relationship with the patient, on the one hand, and throwing out his familiar medical competencies and skills, on the other.

What is the nature of this all-important relationship, and how does it involve the physician?

The answer is surprisingly simple. A large number of the patients who come to see him do so because they feel lonely and unhappy. Many are so miserable that they come to see the physician in desperation. They may not know that their desperation is the reason for visiting him, for each will have a legitimate symptom which brings him. Each will be suffering pain or discomfort. Each comes to the physician because he wants relief from his illness or his fear of illness. He believes that the physician can give this relief. As you well know, many not only expect relief but demand it. These patients expect much from physicians, and it is this intense *expectancy* that determines not only the *nature* but also the *importance* of the patient-relationship. The patient usually does not care what the physician requests or does so long as he gets help and relief.

The emotionally distressed patient seeks some form of *personal attention* from the physician, a recognition, if you wish, of the patient's sense of helplessness in dealing with his environment. He seeks some indication from the physician that the latter has understood what he is trying to communicate. This indication may well be an attentive, listening ear for 10 minutes, a sizing up of the patient's feelings.

The physician gauges the relationship and the feelings, both his own and those of the patient, as he would gauge the effects of medication. Take the example of the patient who typically returns repeatedly and in whom there is nothing seriously wrong organically. The physician comes to know him well. He will often arouse the physician's anger with his demands. The physician can choose to ignore his irritation because he may feel that physicians should not be angry with patients. But the relationship is obviously important to this patient because he keeps returning to the physician. Though he annoys the physician, the patient does not seem to be aware of his doing so.

Instead of ignoring his irritation, the physician decides to look at himself and to accept his emotional reaction to the patient. The next time he sees the patient, he listens. He does not reject the patient with some trite comment or another prescription so as to get rid of him as soon as possible. Instead, the physician gives the patient a reasonable amount of his time, of himself, because he realizes that the *patient cannot help behaving in this way,* irritating people, including the physician. The patient fears rejection but also does not seem to be able to gain acceptance. The physician perceives this in the patient as a part of the patient's illness. He acts accordingly. Instead of allowing the patient to come to see him according to the pressures of the patient's fears and anxieties, he relieves the patient of that responsibility by deciding *when* and for how long the patient will see him. The patient is reassured, and the physician has established a positive therapeutic control, precisely what the patient was seeking.

The physician may well say at this point that to use one's self as a therapeutic device requires some training in psychotherapy. Such a comment is valid. The physician's lack of training in psychotherapy does add to the dilemma about his professional role. Most physicians have had no training in psychotherapy. Contrary to popular belief, the acquisition of psychotherapeutic skills requires years of intensive training. Even for the most skilled of psychotherapists, acquisition of the necessary insight and understanding about his own feelings and those of the patient does not occur in a week, a month, or a year.

Even if the physician has had some little opportunity for training in psychotherapy, he is unlikely to have had any training in psychological theory. Without a firm grounding in theory, there is no logic to psychotherapy, just as without a knowledge of anatomy there would be no logic to surgery.

There is yet another dimension to the dilemma of the professional role of the physician. If he is to make use of himself as a treatment device, he finds that he must now stop *doing* in the sense of taking action himself. When he spends much of his time *listening* instead, he may feel that he is doing nothing, that he is making no use of his professional skills. As a matter of fact, he is actually doing very much, but something different from that which both he and the patient expect him to do.

Traditionally he would be examining, writing case notes, outlining procedures. Now he would seem to be involved in a strange and esoteric process. He may become uncomfortable, wondering if he is "behaving as a doctor should." He may feel that other physicians look upon this sort of behavior as "hand holding," or "soft," or more appropriate to social workers. Until he begins to see the results for himself, he will be tempted repeatedly to abandon the patient and give up.

The Dilemma of Resistances

If someone breaks a leg, has a pain in his chest, or has a troublesome rash on his hands, he will not hesitate to accept that fact and tell the physician. *Not so with the emotionally troubled patient.* In the first place, the patient has to deal with the social stigma attached to anything that even remotely suggests "craziness," "weak will," or feelings that are not socially acceptable—in brief, anything psychiatric. Many physicians strengthen the stigma unwittingly by their attitudes toward psychiatry, which makes it even more difficult for the patient to communicate his worst fears and preoccupations. Instead, the patient falls back on the typical physical symptoms which are socially acceptable and for which the physician is often hard put to find an organic cause.

Such behavior on the part of the patient is not conscious. He does not think that he is deliberately hiding anything. He actually does have pains. He firmly believes the pains are due to organic malfunction. For most people this is the best way they can find to deal with the feared and damning comment that there may be something wrong with their minds, an anticipation that is always in the back of their thoughts. Furthermore, to have a specific physical complaint is to cope with something all of us fear, the unknown. In this case the unknown is mental illness with all its mysteries, to which may be added the distortions of horror stories and newspaper headlines. The patient not only doesn't know what mental illness is all about, but also what little he thinks he knows is so wrong that it increases his fear. Every mention of mental or emotional illness conjures up fearful thoughts of being declared insane, of being locked up, and, above all, the fear of losing one's mind.

To this must be added the fear of any patient of the physician's examination and scrutiny of his personal life, whether inspecting his body or investigating his past illnesses. Further compounding the situation are the patient's already problematic relationships with his family, friends, and fellow workers.

Thus the physician is often confronted by a defensive, hostile, and embarrassed person who is seeking help and yet does not know how to break down his own barriers to obtain it.

The physician sees these resistances in many forms. The patient makes the rounds of physicians or sees several concurrently, each unaware that other physicians are being consulted. He sees resistances conspicuously in the alcoholic patient who refuses more than emergency symptomatic help, despite repeated drinking bouts. Sometimes he sees the depressed patient who denies the seriousness of his illness only to commit suicide. Each physician can add his own examples.

The physician may well ask himself whether he should try to cope with such fixed and baffling resistances. How much simpler to prescribe or operate! Is he not going to sink into a psychological morass if he opens himself up to psychiatric problems?

The Dilemma of Being All Things

The physician in our culture is already labeled as the person to whom anyone can turn with almost any kind of a problem. He is supposed to be an expert on sexual problems, though he learned little about such problems in his training. He is supposed to be a wise counselor, though few have learned formally to counsel. He is supposed to know all of the community resources for social services. In some states he places illegitimate babies for adoption. He is supposed to know the mysterious workings of official agencies should any of his patients get into trouble. And so it goes.

Little wonder, then, that the physician should ask himself whether he wants to be further involved in emotional problems. To become known as one who is sympathetically interested in people and who is helpful in times of emotional stress can add to one's already heavy burdens. Families will turn to him for interpretation and guidance even if the sick member of the family is being treated by a psychiatrist. In a psychiatric emergency, he may be called upon to cope with very frightening and disturbing behavior for which he is neither trained nor prepared.

The third dilemma, then, has to do with his image of himself, and the public's image of him. Does he reinforce the unrealistic image of being all things to all people when he becomes interested in emotional problems? Does he make more "work" for himself? Should he do so?

Toward a Solution

At this point the physician might well feel disheartened with what appears to be an unpleasant, if not impossible, task. It is a difficult one, especially in the beginning, but certainly not an impossible one.

Perhaps the best place to begin is with a perspective. Dr. Paul Pruyser, summarizing group discussions in our 1959 seminar, notes a series of continuities between the traditions and experiences of the physician and the knowledge he is asked to learn concerning emotional problems.

First, there is a continuity of knowledge. Psychiatric knowledge is really not foreign to other medical knowledge. It is capable of being melded into the already established medical frame of reference. So evident is the relationship of mind and body that even the redundant term "psychosomatic" is becoming obsolete.

Second, there is a continuity of attitude. Though the physician trained in medical certainties may be uncomfortable in the fluidity and uncanny inarticulateness of matters psychological, as a matter of fact he is always having to cope with the unknowns in medicine. There is much about physiological functioning that remains mysterious and uncomprehended.

Third, there is a continuity of skill. Given the opportunity to view psychiatric theory and practice, the physician may at first perceive psychotherapy and prescription at extreme ends of a scale. A more proximate look, however, makes it apparent that, with few exceptions, what is done in psychiatric interviews is not really so distant from what the physician ordinarily and comfortably does himself.

Fourth, there is a continuity of professional identity and role. Never does he stop being a physician. Never does he undertake in practice what a physician should not do. In dealing with emotional problems, as with any other problem, his function is clearly that of a healer. The very fact that he is recognized as a healer is a very important part of the healing process.

The meaning of these continuities was succinctly summarized by one seminar participant who said, "I see you psychiatrists differently. You seem more human and closer to me."

Given this perspective, how can we go about solving the dilemmas?

The experiences of our seminars indicate that such meetings are highly useful for the participants. They lend themselves to certain adaptations which might serve the needs of many physicians.

For example, a physician interested in extending his knowledge of psychiatry might well invite several of his colleagues to join him in a series of regular discussions with a local psychiatrist. Such a series, together with outside reading, will have the advantage of relating the physician's day-by-day practice to what he is learning about psychiatry. His own office serves also as his laboratory. This is in the tradition of the *practice* of medicine. Regular meetings permit the integration of knowledge without the pressure of compact seminars.

Such a learning experience with a psychiatrist—and any psychiatrist would be flattered to be invited to consult with such a group—has the advantage of providing a continuous relationship for the discussion of problem cases and dealing with psychiatric emergencies.

In many communities a psychiatrist is not available. A good *clinical* psychologist could be extremely helpful. Sometimes community agencies which deal with specialized problems, such as a center for alcoholics, offer intensive orientation or refresher courses. If an agency does not offer such courses, requests from local physicians would stimulate it quickly to do so.

Where neither local psychiatrists nor specialized agencies can meet the need, requests to mental health divisions of state boards of health, to university extension departments, or to medical school departments of psychiatry for special seminars might produce the teaching and seminar services the physician wants.

These suggestions respond to the first two dilemmas. I think they begin to answer the third as in the course of his psychiatric learning the physician becomes more comfortable with his role.

It should be clear that these suggestions imply a complementary relationship. If the physician is to learn from the psychiatrist, the psychiatrist must also learn from the physician. One of the rewarding experiences of our seminars is the knowledge which the psychiatric staff acquires from the participants. Only in this kind of relationship in which there is mutual give and take can barriers be broken down. As psychiatrist and physician learn to know each other better, the physician's uncertainty in psychiatric emergency will tend to diminish. He will find also that he no longer needs to carry the burden of his emotionally troubled patients by himself, nor to be so concerned about his own limitations.

Similar efforts with other medical specialties have been highly succesful. They should be equally so with psychiatry.

(The author's address is Division of Industrial Mental Health, The Menninger Foundation, Topeka, Kan.)

Dilemmas of the Occupational Physician in Mental Health Programming — Part II

Harry Levinson, Ph.D., Topeka, Kan.

SEVERAL years ago the *Wall Street Journal* carried a feature article describing various mental health problems and programs in industry. Shortly after he had read the article, the president of a widely known company called his medical director to ask what the latter was doing about mental health in their organization. Fortunately, in this case, the medical director was able to reply in some detail, but many medical directors are not so fortunate.

Increasingly, as more articles, more seminars, and more public attention focus on mental health, the occupational physician finds himself the person in the business organization who is supposed to do something about it. Health is his professional concern. He speaks of occupational health and of the total working environment as his province. It is only natural that management should turn to him on such a subject.

Many occupational physicians, however, with inadequate training in psychiatry in medical school, can only ask themselves the questions, "What is this mental health business all about?" and "Where do I begin?" Now the problem is no longer that of merely referring a neurotic employee to a psychiatrist or seeing to it that a psychotic employee is taken to a hospital. The task becomes one of creating a mental-health program, which, like other health programs in industry, should have as its aim keeping well people well. Little wonder, then, that the average occupational physician should find himself somewhat at sea, without a vision of the shore—where he might be going—to guide him.

Even those occupational physicians who have had an opportunity to become more sophisticated about psychiatry sometimes are not much better off. The position of the occupational physician within the business organization, by and large, is not a policy making position. Seldom is he given an opportunity to contribute significantly to administrative changes within the company. He has little to say about the emotional climate of his organization or about the personnel policies which create that climate. I have yet to meet an occupational physician who has been called in by his management to consult on the planning of a new plant with respect to the implications that the plans have for how people will feel about themselves and their work.

Furthermore, the occupational physician is often a single person within a complex structure of many divisions and subdivisions, each of which is compounded by layer upon layer of management. In many instances there are additional relationships to unions which also must be considered. Sometimes he asks himself in sheer desperation, "What am I supposed to do?"

In either of these two dilemmas, the first reaction of the occupational physician is to turn to someone who is supposed to know about mental health in industry to ask for a set of rules or procedures. This is not an inappropriate reaction, for with many other aspects of the medical program he can do just this. For toxicological problems, industrial accidents, even alcoholism, there are formalized steps and programs. It is not unusual in industry to have consultants plan a complete program for any department. Frequently we are asked to spell out in one-two-three fashion exactly how a mental health program should be set up in industry.

The second reaction is to think of screening out employees who are emotionally disturbed or prospective employees who are likely to

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become mentally ill. Seldom does a week go by in which we do not get a request from someone asking for an instrument or device which will screen out such people simply and quickly.

When we reply that there are no rules for setting up a mental health program which apply to all plants, the occupational physician is chagrined. When we add that there are no adequate devices to screen out any but the most blatantly sick people, nor can one predict those who might break down, his chagrin becomes frustration. Finally, when we say that the task is not to eliminate people, for all of us are emotionally disturbed at one time or another, but rather to effect the best placement psychologically as he already tries to do in terms of physical capacities, the occupational physician shakes his head in futility.

This is the point at which the occupational physician becomes most impatient with psychiatry and mental health. Dr. David Goldstein, in personal conversation, vividly describes the syndrome which the occupational physician experiences—the sinking feeling in the pit of his stomach, the rising anger, the sense of helplessness, the wish that psychiatry would go away and leave him alone. The feeling tone, Dr. Goldstein says, is one of depression.

As if these were not problems enough, there are yet further dilemmas. Not infrequently the occupational physician has had unpleasant experiences with psychiatric consultants. Seldom do they tell him what he really wants to know about the patients. Sometimes the psychiatric reports are so full of jargon that the occupational physician cannot understand them. As the occupational physician sees it, the psychiatrist frequently indulges in circumlocutions to avoid saying anything about the patient, leaving the occupational physician with little basis for making the medical judgments for which he is responsible. He asks for recommendations about the patient's job assignment but gets none. Sometimes, even worse, the recommendations are unrealistic, for the consultant knows neither the plant nor the work. Further than that, he must also cope with the general practitioner, who sees many of the employees who are emotionally disturbed and takes the easy way out by prescribing vacations or job assignments which are impractical if not impossible.

The Goldstein syndrome now changes to include a new element—a figurative claustrophobia. The occupational physician feels as if he were in the center of a square with pressures coming from each corner. In one corner is management, which demands that he do something but seldom provides him with either the power or the resources with which to do it. Rarely does management understand the full implications of what needs to be done, management's role in any program, and the professional limitations of the occupational physician. Furthermore, in management's corner there may well be others with different responsibilities who are more familiar with concepts of mental health than he: psychologists, personnel men, sociologists, training directors, to name just a few.

In another corner are the employees for whom he has responsibility. More often than not, they do not want to recognize problems as being emotional in origin. Rare is the boss at whatever level who is willing to accept the possibility that his behavior may precipitate symptoms in subordinates. In a plant with which I am familiar, a union publication bitterly attacked the occupational physician for referring employees to a psychiatrist instead of giving them aspirin and tranquilizers for their repeated complaints. I doubt that the same physician would have been attacked for referrals to internists, gynecologists, or surgeons. And even for those who are willing to recognize emotional components of illness, the occupational physician not infrequently asks himself whether he has any right as an employee of a business organization to invade the psychological privacy of other employees.

In the third corner is psychiatry—that mysterious, nebulous, complex body of esoteric theory and skills which seems so difficult to understand, let alone apply. The occupational physician is aghast at the idea that in advanced psychiatric thinking diagnosis no longer has much meaning.* Certainly there is nothing in psychiatry like the one-to-one relationship between diagnosis and treatment in physical illness. The occupational physician is somewhat uncomfortable also with the thought that perhaps, from his ivory-towered perch, the psychiatrist may be looking down condescendingly upon him.

In the fourth corner is the rest of medicine and the conflictful position of the occupational physician with respect to it. Though the occupational physician is on a frontier of medicine, most of his professional colleagues in other branches of medicine have neither the experience nor the vision to see the horizons. There is a continuing problem between the

*In the sense that traditional nomenclature has limited usefulness.

occupational physician and other physicians about the limits and functions of his role in industry. He remains yet uncomfortable in his newly developing field for, like the psychiatrist, he is still viewed by so many colleagues as a second-hand doctor.

Were this delineation of dilemmas the complete picture, the occupational physician would be paralyzed into inaction. Fortunately, he is more resourceful than to allow himself to be so bound. He begins to escape from his dilemmas by tearing down his own barriers and prejudices about psychiatry. He begins to learn something about psychiatry—what it really is and not what his medical school prejudices have led him to think about it.

Although psychiatric syndromes are not nearly so specific as many syndromes in physical medicine, he can quickly recognize processes of anabolism and catabolism in the personality, much like those he sees in cells. Cannon's theory of homeostasis, so basic to physiological equilibrium, has correlates in psychic equilibrium. The symptom in psychiatry, as the symptom in any other branch of medicine, has a protective and defensive function. With study, its meaning can be understood. Like any other symptom, it will disappear when it is no longer needed. One can think also of an anatomy and physiology of the personality.

As these concepts, together with those of the unconscious mental processes and personality mechanisms, acquire meaning, and as he sees the broad continuity of psychological medicine with the rest of medicine, the occupational physician begins to lose some of his resistances to psychiatry. As he becomes aware of his own resistances by their disappearance, he also begins to realize more clearly the resistances on the part of others with which he will have to cope.

Before long in his exposure to psychiatry, it becomes apparent to the occupational physician that psychiatric aspects of his practice do not lend themselves to assembly line methods. At first he becomes concerned that he hasn't the time to devote to each patient that even emotional first aid requires. Then he realizes that he sees many patients repeatedly for nonpsychiatric complaints if he does not spend enough time with them in the beginning. Aware now that time is part of his therapeutic armamentarium, the reality of his time limitations becomes clearer. Although he may spend more time per visit, he will necessarily have to limit the number of visits for a given problem. Even if time alone were not to require limits of him, his minimal training in psychotherapy would. Both of these factors set the realistic limits of what he can do.

Furthermore, he becomes aware also of the limitations of psychological and psychiatric knowledge. With this awareness there is decreasing tension: "There are a lot of things about mental health in industry that no one else knows either." With less tension, he can take a new look at himself and his organization to see what is practicable and possible. He can begin to establish working ties more comfortably with others in the company whose work relates to mental health.

Along with his recognition of his own limitation comes a critically important insight: He becomes aware of his psychological importance to the patients he sees and of the therapeutic value of himself as a person. He no longer feels impelled to "push pills," nor is he so impatient with himself for not "pushing pills." He is more comfortable with himself and his role as an occupational physician, even if at times he may seem to be doing nothing specific for the patient's complaints.

He recognizes that he is in much the same position as a first-level supervisor or middle management executive who has learned about human relations. In order to be able to do anything with what he has learned, he must be able to enlist the support and participation of management. If he does not do so, no program will succeed. As a staff person he will need to work through others. Perhaps the two most important steps he can take in a mental health program are to encourage and wait—wait patiently until some problem or event makes movement possible. Just as one must wait for the patient to hurt enough to want help with his emotional problem, so he must often wait until management hurts enough to want seriously the right kind of mental health program.

He realizes, too, that if he can take the first step with management the problems of the next steps probably will be solved more readily. The question of the invasion of psychological privacy, for example, no longer seems so pressing a question. The physician historically represents a person in whom anyone may confide. If the employee himself opens up spontaneously to the physician, then by so doing he has given the physician the permission to enter his private psychological world. If he does not do so, there is no way in which the physician can enter that world. The role, then, is not one of an invader but one of the ideal function of the healer.

But now there is also another role with which the occupational physician usually is much less familiar. In addition to his relationship with individual employees, the physician who undertakes a mental health program in industry is called upon to communicate mental health knowledge, to develop nurses and supervisors as his "outposts." Thus he becomes a teacher, not just for one course or one lecture, but almost continuously. He expands his function from that of a person who himself performs professional skills to that of one who teaches others to perform at subprofessional levels. And it is here that he confronts most conspicuously the anxieties and resistances that are the inevitable accompaniment of the teaching of psychology and psychiatry. Remembering his own anxieties in learning, he will recognize that patience and support will be his most useful instruments.

For some occupational physicians, of course, the dilemmas will seem insurmountable, and the physicians will retreat. Or, perhaps they will lash out in hostile denial of the validity of psychological knowledge. Others will have to wait patiently for years until the first breakthrough becomes possible. For still others, however, a beginning is possible now. The changing status of occupational medicine, the increasing understanding of psychiatry, and the manner in which life in our society has become so intimately bound up with work, all create for the occupational physician the possibility of unique contributions to the health of millions of people.

Earlier in my presentation I said that the occupational physician was in the center of a square, beset by forces from each corner which compounded a series of dilemmas. The solution lies not in attacking in any one corner but in rising above the field of conflicting forces to a new level of practice.

(Dr. Levinson's address is The Menninger Foundation, Topeka, Kansas.)

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Dilemmas of the Occupational Physician in Mental Health Programming — Part III

L. Holland Whitney, M.D., New York, N. Y.

MENTAL illness is considered to be the Number 1 public health problem of our times. The National Institute of Mental Health of the United States Public Health Service estimates that one of every two hospital beds in this country is occupied by a mental patient. It is also estimated that there are an additional 9,000,000 of the population, who are not hospitalized, suffering from emotional disorders severe enough to prevent their leading fully productive and socially useful lives.

In view of the large segment of the total population currently employed in industry, it is apparent that emotional illness is a factor of considerable importance to the national economy and industrial efficiency in general. This may manifest itself on the industrial scene in poor attitudes, grievances, tardiness, absenteeism, and accidents, or in other, less apparent, manners. Studies which have been made in the industrial setting indicate clearly the impact of disorders of feeling state, thought, and behavior on the numbers of visits to an industrial medical department, accidents, and disability absence. It is not surprising, therefore, that increased thought and attention are being given to this health factor in industrial medical programs.

In order to explore the needs and goals of the field of mental health, let us first review some of the base lines from which we might take off. Private industry is in business to provide goods or services for a profit; and experience has demonstrated that properly applied medical skills can contribute to this objective. Industrial medical programs are founded on the premise that there is a relationship and interdependence between the health of employees and their effectiveness in industry. Although the maintenance of good health is primarily a personal responsibility, industry has an obligation by law and an opportunity to utilize available techniques for the prevention of disease and injury and the promotions of optimal health and productivity. When industrial activities in the medical field are kept in proper perspective, they can be carried out without infringement on private medicine. Within the confines of good industrial management and accepted principles of occupational medical practice, there is need for increased attention to the human element in the business.

My fellow panelists have described some of the problems which confront all of us in the development of a mental health program. Their comments are the more significant because they are based on contacts and dealings with physicians and representatives of management who are actively engaged in the industrial field. Identification of the dilemmas faced are a big step toward their solution. Both of the previous speakers have made constructive suggestions on how we might proceed in an orderly fashion with a good outlook for progress. A better understanding of the principles of and the psychiatric approach to therapy will surely enhance the professional skills of the industrial nurse and physician. Some specific suggestions as to how this orientation can be accomplished have been made.

It has been traditional in medicine to think of health as the absence of disease, despite the inadequacy of this concept. Much progress has been made in control of the physical and biological environment, with little consideration to the emotional impact of the surroundings. Perhaps we should train ourselves to look at sickness in terms of the people who are ill rather than in terms of the agents which cause disease. From personal experience in industrial medicine, some practical approaches to the de-

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Presented at the Forty-Fourth Annual Meeting of the Industrial Medical Association, Chicago, Ill., April 30, 1959.

velopment of a mental health program are suggested. Most of these are restatements of principles which have already been made by the previous speakers but from a slightly different viewpoint.

Fundamental to the success of any program is the quality of medicine which is offered. To be a good nurse or a good physician, it is essential that we have a sincere interest in the individual patient and the problem which he faces. Without any prejudice to this time-honored relationship, our training must also encourage us to locate trouble spots in the industrial environment and consider the underlying cause. This does not mean that we are expected to function as pseudopsychiatrists; but with proper motivation our professional talents can effectively provide guidance and advice to individuals, employee groups, and to the management on the work environment.

The first line of defense against undue emotional stress lies with the immediate supervisor. His awareness and understanding of some of the basic emotional needs of his employees is prevention of the first order. This is further augmented by the supervisor's willingness to listen, and to see a problem objectively from the other fellow's viewpoint. The occasional employee who presents a persistent problem can be identified usually without much difficulty and referred to the medical facility. And here, again, if simple "first aid" measures do not suffice, the alert nurse and physician team will arrange for prompt referral to specialized medical assistance.

The creation of a favorable climate is a responsibility of supervision and the sign of a progressive management. This will go a long way toward maintaining a healthy environment in its broadest sense. Opportunities for the medical staff to participate in supervisory training courses make possible a discussion of some of the factors which are known to be important.

A knowledge of the community resources for the management of problem cases is also essential. Wherever possible this can best be handled by close cooperation with the private physician. As a better understanding of psychiatric principles is developed, our liaison with the specialists is more effective and the end result of cooperative efforts are bound to be improved.

An intimate knowledge of the work environment, job demands, proper placement, counseling, rehabilitation, and health education are all essentials to the establishment of a program of mental health in industry. It is unnecessary for me to elaborate further on the principles already outlined by my associates on the panel. May I endorse the suggestions which they have made and indicate my conviction that this field of endeavor requires hard work and possibly some reorientation of our thinking. The rewards for these efforts will be great indeed.

(The author's address is 195 Broadway, New York 7, N. Y.)

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Some Phosphate Ester Insecticides of Lesser Toxicity for Man

D. O. Hamblin, M.D., New York, N.Y.

THE ORGANOPHOSPHORUS, or phosphate ester, insecticides have, in the past few years, played an increasingly important role as pesticides.

The work of Schrader in Germany was largely responsible for the development of this interesting and important group of compounds. The remaining records of his work in this field (some of which had been destroyed) fell into the hands of the British and Russians during the latter days of World War II. Of these compounds, many were of such a nature, physically and pharmacologically, that they were being tested for their practicability as chemical warfare agents.[1] In 1947 British Intelligence released portions of these captured documents, or records, which appeared to have no particular military significance.[2]

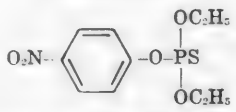
Several of these compounds were then synthesized in the United States and elsewhere and tested for their efficacy as pesticides, chiefly insecticides. Some were introduced commercially for the control of insects in the United States, Germany, Britain, France, and, subsequently, in Japan. It was chiefly parathion and TEPP (tetraethylpyrophosphate) which proved to be economically successful.[3,4,5,7] Both of these are highly toxic to warm-blooded animals as well as to insects. Because of their high toxicity to warm-blooded animals, chemists in the countries previously mentioned have experimentally produced hundreds of derivatives, or homologues, of these two compounds. The aim was to synthesize, if possible, one or more compounds which would be effective insecticides but with a low order of mammalian toxicity. All those preparations which have been of commercial promise are esters of phosphoric acid, thiophosphoric acid, or dithiophosphoric acid.[8]

Dr. Hamblin is a consultant in occupational medicine.

The whole class of compounds has, to a greater or lesser degree, the common pharmacological property of interfering with enzymes which catalyze the hydrolysis of esters of choline and, more specifically, acetylcholine. Their action inhibits the cholinesterases which normally destroy acetylcholine as it is formed to mediate impulses in the postganglionic parasympathetic and preganglionic sympathetic synapses.[6] Thus, poisoning by these compounds is characterized by intense parasympathetic stimulation.

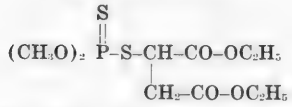
The quest for a compound which was significantly less toxic to mammals and yet retained an effective degree of insecticidal activity was altogether empirical and protracted.[8] Hundreds of phosphate esters were synthesized, many of which proved to present an order of toxicity to warm-blooded animals and insects more or less similar to, or greater than, parathion without demonstrating any clear-cut advantages over this compound, which was originally designated E-605 by Schrader. As a matter of practical importance, it probably is not feasible to apply as an insecticide any of this class of compounds which is appreciably more toxic to man than is parathion. After years of research in various chemical laboratories here and abroad, there emerged three compounds with relatively much lower toxicity to mammals and with varying degrees of efficacy as insecticides. The three substances that withstood intensive screening and appeared worthy of commercial presentation were malathion, Chlorthion, and Dipterex.

PARATHION



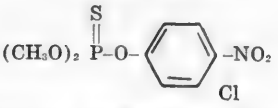
O,O-diethyl-O-*p*-nitrophenyl thiophosphate

MALATHION



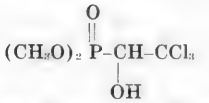
O,O-dimethyl phosphorodithioate of diethyl mercaptosuccinate

CHLORTHION



O-3-Chloro-4-nitrophenyl-O,O-dimethyl phosphorothioate

DIPTEREX



Dimethyl(2,2,2-trichloro-1-hydroxyethyl) phosphonate

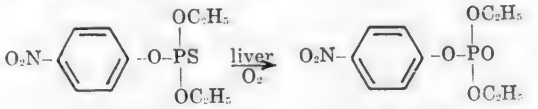
Of these compounds, malathion alone excelled in the tests of practical commercial application and clearly demonstrated its value as a more versatile insecticide and miticide, with sufficiently low mammalian toxicity to win, to date, an unparalleled degree of label acceptance by the Food and Drug Administration of the United States and the U. S. Department of Agriculture.

The Department of Agriculture has designated malathion as among the safest insecticides being marketed and has further approved its application to a greater variety of crops than any phosphate ester insecticide in existence. Its low order of toxicity for mammals was so clearly established that a residue tolerance on many food crops of 8 ppm was granted. It has label acceptance for direct application to a variety of animals, such as dogs, cats, cattle, and poultry, in the form of a 1% spray or 4% dusting powder.[9] It was the first product of the phosphate class which was accepted for indoor household application.

Impressive demonstrations of its low toxicity for man came with the widespread use of malathion to stop abruptly an invasion of the Mediterranean fruit fly in the Florida citrus groves, and its success in California in killing mosquitoes which were vectors of encephalitis.[10,11] The public health authorities, both federal and state, in stemming the Mediterranean fruit fly outbreak, approved its use for spraying from aircraft over densely populated areas. It is of great interest that no single case of poisoning occurred in the exposed population in Florida during the application by airplane of a 25% wettable powder diluted to about 5% and totaling more than 3,000,000 lbs. of malathion (technical grade). It has also proved its value in killing flies and other insects which had become DDT-resistant. A disadvantage is that, as compared with parathion, two to three times more malathion is required by weight per unit of insecticidal efficacy. Hence, its cost is greater per application than that of parathion. Further, it has a short residual activity which, in some instances, is a disadvantage but, on the other hand, means that it can be applied closer to harvest time than most compounds of this class, i.e., seven days before harvest.

Parathion is, to date, one of the most effective insecticides marketed, and its sales far exceed those of any other phosphate ester. It is a versatile insecticide, but its very high toxicity for warm-blooded, as well as cold-blooded, animals remains its greatest disadvantage. It has been responsible for numerous deaths and severe poisonings all over the world. Its pharmacology and toxicology have been described at length in numerous publications and will not be repeated here. Its LD_{50} for most species of warm-blooded animals is reported as 4 to 15 mg/kg. The LD_{50} for malathion in rats, which is fairly characteristic for most species, is in the neighborhood of 2,500 mg/kg. Both of these compounds exert their effect primarily through the inhibition of cholinesterase. While they are qualitatively similar in action, there is a vast disparity quantitatively as indicated by the LD_{50}'s referred to previously.

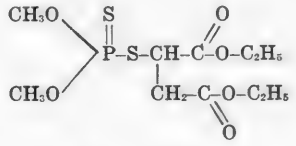
It has been demonstrated in vitro that on incubation with liver slices in the presence of oxygen parathion is converted to a much more toxic compound, paraoxon (its oxygen analogue). It is believed that this mechanism obtains in vivo as well as in vitro.[12-16] Thus, upon the absorption of parathion, it is thought that an enzyme of the liver increases the cholinesterase-inhibiting powers by conversion to the oxygen analogue.



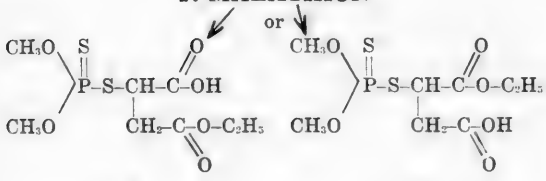
PARATHION **PARAOXON**

On the other hand, enzymes, chiefly those of the liver, are thought to degrade malathion by hydrolyzing the ester linkage in the 1,2-dicarbethoxyethyl side-chains and thus serve to

detoxify malathion.[14] We have, therefore, an apparent anomaly in the function of tissue enzymes. In the case of parathion, they enhance the toxicity of an already highly-toxic compound, as contrasted with the metabolism of malathion, which, already a relatively poor cholinesterase inhibitor, is converted into an even less toxic compound (after Cook et al.[19]).



I: MALATHION



II **III**

It has been postulated by O'Brien and others that malathion, in a manner similar to that of parathion, is likewise converted to malaoxon by tissue enzymes. In vitro studies, chiefly with liver homogenates and cockroach gut,[11] demonstrate that malathion, in its unoxidized form, does not inhibit cholinesterase. It is necessary to oxidize malathion by the use of bromine or similar oxidizing agents to demonstrate anticholinesterase activity. Whether or not in vivo malathion is converted to malaoxon appears to be of largely academic interest, since the hydrolysis of the ester linkage in the 1,2-dicarbethoxyethyl side-chains proceeds much more rapidly than does the formation of the oxygen analogue.

Comparatively few data are available on the pharmacology of Chlorthion and Dipterex since they, for a variety of reasons, have not attained any great commercial volume of application. The LD_{50} in rats for the former is reported as 1500 mg/kg and for the latter, 500 mg/kg.[18]

Poisoning from the field application of malathion is virtually unheard of. In the few reported instances in which malathion has been ingested with suicidal intent, atropine in massive doses has been the antidote of choice. It should be administered as described in the many papers dealing with parathion poisoning.

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The "How" of an Industrial Gynecologic Survey

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Carl S. Plumb, M.D., New Haven, Conn.
Margaret DeBord, B.S.N., Pisgah Forest, N.C.

THE BIBLICAL quotation, "Seek and ye shall find" has a gratifying application in gynecology, and the variety and percentage of positive diagnostic yields in gynecologic surveys can be rather accurately predicted. This presentation is not primarily a gynecologic review; instead, it is a condensed account of three years' experience in conducting a gynecologic survey within the framework of industrial medicine. This discussion is primarily directed toward those industrial physicians and nurses who may be interested in carrying out a similar type of survey. The slant is administrative and procedural. Hints are offered on what to clear with management, how to approach patients, what sort of equipment will be needed, where and how professional assistance can be obtained, procedures to be carried out, the importance of follow-up, the costs, and the results to be expected.

Laying the Groundwork

As in the initiation of any new project, it is prudent to establish a foundation of understanding in certain areas:

1. *Management*—The expense of the survey comes within the legitimate interest of management. Costs should be anticipated and budgeted. Management should be warned of a probable temporary increase in number of claims of gynecologic origin against health insurance plans. The wisdom of seeking early diagnosis at a stage when therapy has its greatest chance for success is apparent to all thoughtful persons. Loss caused by neglect, in terms of both human suffering and reduced work efficiency, should be emphasized. These ideas will carry weight when discussing a possible survey with policy-making management.

2. *Patients*—Female employees usually accept a gynecologic survey with enthusiasm and even with gratitude. A five-minute speech in a locker room at shift-change time is one good way to announce the survey. The motives of the examining service should be carefully explained. It can be emphasized that case-finding surveys are most valuable when performed on so-called well patients, before symptoms develop. Also to be emphasized is the privacy in which the examinations will be conducted. Prospective participants should be informed that abnormalities will be explained to them and that, when appropriate, records will be transferred to the physician of their choice. After the locker-room meeting, a nurse, forewoman, or female supervisor can collect the names of those wishing to participate.

3. *Local Physicians*—Some few private practitioners may have misgivings concerning the effect which an industrial gynecologic survey may have on their private practice. When the true case-finding motives are defined, however, most private practitioners will harness their objections. Clear explanation of the system for referral will usually take the sting out of critical inquiries.

Scheduling

Careful scheduling will contribute to smooth operation; certainly it will reduce unnecessary absence of the patients from work areas. It is usually necessary to coordinate scheduling with departmental supervisors. In order to achieve maximum participation, it may be desirable to hold the clinic one day a week for as many weeks as are necessary to accommodate the entire female plant population. This will allow women working on rotating shifts to be exam-

This article is revised from a paper presented by Dr. Gasque at the Forty-Fourth Annual Meeting of the Industrial Medical Association, Chicago, Ill., April 30, 1959.

From the Industrial Medical Department of Olin Mathieson Chemical Corporation, Pisgah Forest, N. C.

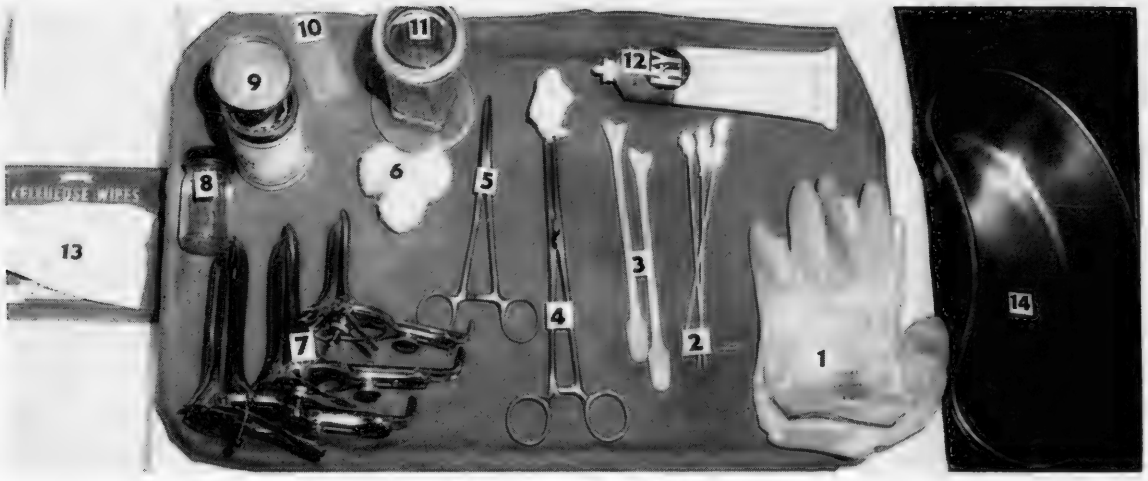


Fig. 1—Instrument Tray

1. Rubber gloves
2. Cotton applicators
3. Special spatulas for collecting material for cytological examination
4. Sponge forceps
5. Curved hemostat
6. Cotton balls
7. Vaginal specula
8 and 9. Container and mailing carton for biopsy specimen
10. Glass slides
11. Container for fixing solution for cytological specimens
12. Lubricant
13. Absorbent tissue
14. Utility basin

ined when they are on the day or afternoon shift. Each gynecologist can accept a new patient every 10 to 12 minutes. This allows sufficient time for review of the history, performance of the examination, and a brief interpretation of findings.

Equipment

Good equipment and adequate supplies are important in order for the clinic to operate smoothly. Specific items are shown in Fig. 1. Most necessary supplies are standard items in an industrial medical department. Glassware required for the processing of cytological smears should be available.

Each gynecologist should have the use of two tables. Elaborate examining tables are nice when available, but they are not at all necessary. An ordinary padded-top examining table can quite well serve the purpose when it is equipped with stirrups. An example of such a table is shown in Fig. 2. Often it is possible to have stirrups made in the plant machine shop (Fig. 3). The cost of this table is only a fraction of the cost of the fancy store-bought variety.

Personnel Required

1. *Physicians*—In selecting physicians to perform the examinations, a panel of recognized gynecologic specialists practicing in the vicinity should be objectively designated. After the motive of the survey is explained, gynecologists usually are quite willing to participate.

Fig. 2—Improvised Gynecologic Examining Cubicle

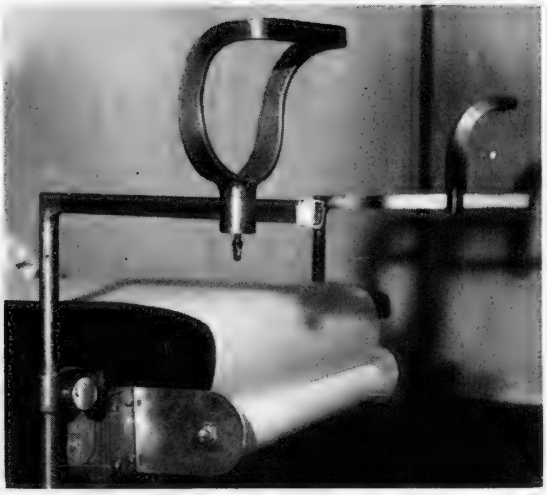


Fig. 3—Homemade Stirrup Assembly

2. *Nurses*—Nurse-assistant/chaperon requirements can usually be contained within the framework of the existing nursing staff.

3. *Technician*—A technician, when available, can be very helpful in performing routine laboratory procedures and in processing biopsy or cytological specimens.

4. *Stenographer*—Stenographic assistance can be most helpful in recording notes, transmitting findings, and similar services.

Gynecologic History

Before the examining physician sees his patient, a pertinent history should be obtained by a nurse or a clinical clerk type of assistant. The history may be recorded on a form similar to the one shown in Fig. 4.

The Examination

Patients frequently discuss their examinations among themselves, and routines should be uniform. For this reason, it is proper to offer the gynecologists orienting suggestions concerning survey motives and routines. This can be done by means of a prepared memorandum, an example of which follows:

Suggestions to Visiting Gynecologists

In order to achieve a maximum of quality and quantity in our Gynecologic Survey, the following suggestions are offered:

1. The examinations will get under way promptly at 2:00 p. m. Thursday afternoons. Examining physicians should arrive not later than 1:45 in order to familiarize themselves with physical equipment, history questionnaires and general routines, get fitted in a white coat, etc. Approximately twenty-five patients will be scheduled to see each physician, and this will necessitate rather close adherence to schedule.

2. Proposed procedures to be carried out in these examination are as follows:

A. Review of the history questionnaire and extension of questioning, depending on the judgment of the examiner.

B. Observation and palpation of the thyroid gland and neck, breasts and axillae, abdomen and skin.

C. Auscultation of the heart.

D. Pelvic examination with collection of cytological specimen and, when indicated, cervical biopsy.

E. Rectal examination.

3. Please give the patient an interpretive summary of your findings. Use the same cheerful and, if necessary, detailed communicativeness that is characteristic of your private practice.

4. In writing up the results of the examination, please write as plainly as possible. Use black or contrasting ink, and please avoid the use of abbreviations, shorthand or symbols, especially when these are not in general usage. In all cases where abnormalities are found which require additional study or therapy, a note should be written or dictated which reflects your diagnostic impressions and your proposals for additional diagnostic or therapeutic care.

Examining physicians are requested to be critical of all procedures and routines and to offer suggestions for improvement of the survey service.

(signed) Medical Director

(Date)

Upon arrival at the medical department, each patient should be instructed to empty her bladder. If facilities and personnel are available for urine examination, a specimen can be collected at this time.

When the gynecologist comes into the presence of his industrial patient, he should muster all the cheerful courtesy and communicativeness which is characteristic in his private practice.

In this regard, the nurse-chaperon can be helpful by introducing the doctor to his patient. While the nurse is preparing the patient for examination, the gynecologist can review her history.

Procedures which are carried out during the examination can vary, of course, but the following have been found to be satisfactory: (1) observation and palpation of the thyroid gland and neck, breasts and axillae, abdomen and skin; (2) auscultation of the heart; (3) pelvic examination with collection of cytological specimen and, when indicated, cervical biopsy; and (4) rectal examination.

Follow-Up

The gathering of clinical facts may have academic value, but the health of industrial workers is not likely to be improved unless there is a careful and persistent follow-up of patients with abnormalities. Following is a routine found to be effective:

1. When significant abnormalities are encountered, a down-to-earth explanation should be given to the patient. The need for continued examination or treatment at the hands of her personal physician should be emphasized.

2. After the examination, a clinical note precisely describing all abnormalities and recommending additional study or therapy should be written or dictated.

3. A copy of the gynecologist's statement should be sent in a letter to the patient's personal physician. With this letter the industrial medical department should enclose a self-addressed postal card, preprinted with the following statement:

> Patient No. _____ reported on (date) _____ for her initial examination.

The patient's code number is inserted by the industrial medical department. The private physician is requested to fill in the date, sign, and return the card. When the card is returned, perhaps then, and only then, can the industrial physician assume that responsibility for the patient has been transferred.

Since corrective action is the essential object of the examining service, anything less than this type of follow-up and transfer is likely to result in a breakdown of the system.

The Costs

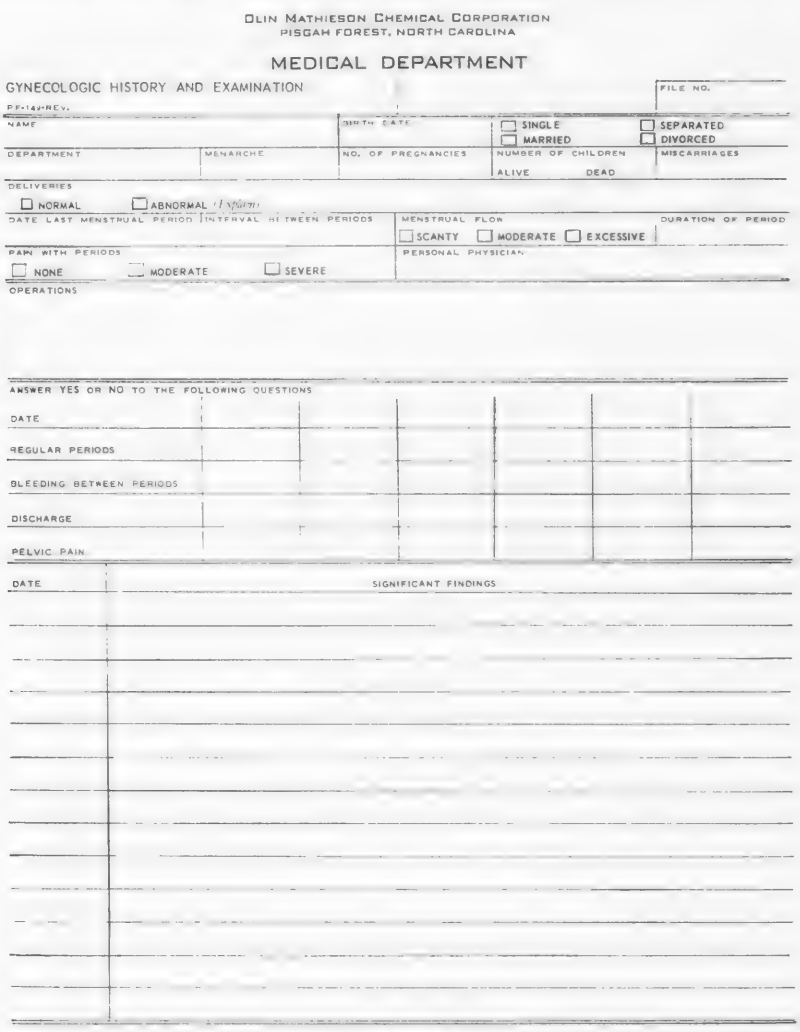
The cost of the survey need not be great. Local rates for an afternoon consultation, such as those established by Veterans Administration Hospitals, can well serve as a guide in establishing gynecologic consultant fees. Industrial staff nurses can provide the additional professional assistance required. Occasionally it may be necessary to call in a relief nurse or have a regular nurse come early and stay late.

In some cities or states, Papanicolaou-type cytological examinations are available without cost through local or state health departments. The cost of extra supplies is small.

Using the personnel and equipment already available in an industrial medical office, these examinations can be carried out at an additional cost of approximately three dollars per patient. This does not include a fee for the cytological examination.

The Results

In carrying out a gynecologic survey of the sort described, the authors found employee acceptance to be good, with approximately 80% of all female employees voluntarily attending the first clinic. At subsequent examinations, many of these same women returned, along with almost the entire remaining 20% who did not attend the first clinic.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PISGAH FOREST, NORTH CAROLINA

MEDICAL DEPARTMENT

GYNECOLOGIC HISTORY AND EXAMINATION

FILE NO.

PF-14-REV.

NAME | BIRTH DATE | ☐ SINGLE ☐ MARRIED ☐ SEPARATED ☐ DIVORCED

DEPARTMENT | MENARCHE | NO. OF PREGNANCIES | NUMBER OF CHILDREN ALIVE DEAD | MISCARRIAGES

DELIVERIES

☐ NORMAL ☐ ABNORMAL (Explain)

DATE LAST MENSTRUAL PERIOD | INTERVAL BETWEEN PERIODS | MENSTRUAL FLOW ☐ SCANTY ☐ MODERATE ☐ EXCESSIVE | DURATION OF PERIOD

PAIN WITH PERIODS ☐ NONE ☐ MODERATE ☐ SEVERE | PERSONAL PHYSICIAN

OPERATIONS

ANSWER YES OR NO TO THE FOLLOWING QUESTIONS

	DATE					
REGULAR PERIODS						
BLEEDING BETWEEN PERIODS						
DISCHARGE						
PELVIC PAIN						

DATE	SIGNIFICANT FINDINGS

Figure 4

Table I—Interval Since Last Gynecologic Examination

Less Than 2 Years	2-5 Years	More Than 5 Years
52%	23%	25%

If female employees were regularly receiving gynecologic care or observation, the examining service would not have been needed. But this was not the case, since 48% of the women had received no gynecologic appraisal within the last two years. For 25% of the women, a period of five years or more had passed since their last pelvic examination. Apparently, then, the service did reach a group of women who otherwise would have allowed neglect to become protracted.

Abnormalities of a degree requiring therapy or additional study were encountered at a relatively uniform rate, with approximately one-fourth of the patients at each clinic being referred to outside medical agencies.

The uniformity of the referral rate may reflect an index of the attrition of gynecologic pathology. If this is a valid conclusion, then it would appear that the uniform frequency of abnormalities justifies annual examinations.

Is It Worth It?

The described survey has received grateful employee acceptance. The diagnostic yield was abundant. Additional dividends were achieved in terms of increased employee participation in the over-all industrial health program. Management has recognized the contribution to general female employee morale. Professional relationships with physicians in the community were strengthened. Local doctors have come to regard the gynecologic examining service as a contribution to community health as well as a case-finding system which has been beneficial to their private practice.

The most rewarding answer to the question "Is it worth it?" lies in the fact that early, asymptomatic malignant conditions were found in four of the patients examined. All of these women have received indicated therapy, and all have returned to their jobs and to their families.

Table II—Frequency of Referral

Year	Patients No.	Referrals No.	Referrals %
1956	316	80	25
1957			
New	58	18	
Old	142	38	
Total	200	56	28
1958			
New	53	21	
Old	155	29	
Total	208	50	24

Summary

This article describes the administrative and procedural aspects of an industrial gynecologic survey. A three-year experience supports the idea that it is practical and economical to integrate a gynecologic survey into an average industrial medical program. The ready availability of examinations in an industrial setting brings many women (25%) into a survey who otherwise would allow gynecologic neglect to become protracted.

Careful advance planning will contribute to smooth operation. Assembly-line techniques are necessary to achieve volume, but a prevailing climate of warmth and personal interest can add much to employee acceptance. Women working in close proximity often discuss their experiences, and as a consequence examining techniques and routines should be uniform. An orderly and persistent follow-up may be necessary in order to consummate referrals.

The frequency rate of abnormalities justifies annual examinations.

(Dr. Gasque's address is Olin Mathieson Chemical Corporation, Pisgah Forest, N. C.)

1960 Annual Meeting and Scientific Sessions
of the
American Heart Association
will be held
October 21-25 in St. Louis

For further information, write: American Heart Association, 44 East 23rd Street, New York 10, N.Y.

Newer Concepts of Low Back Pain

M. Laurens Rowe, M.D., Rochester, N.Y.

NO WORDS need be wasted in promoting the recognition of the surpassing importance of low back pain in industry. Ranked number one in production of lost time and permanency in compensation cases, low back conditions are also top contenders for the same position among the causes of absence from work due to sickness.

Nor has the low back problem gone unrecorded in the literature. Thousands of papers by hundreds of capable observers have sought to describe, clarify, or solve the problem. The current medical generation has seen the sacroiliac strain displaced in diagnostic popularity by the lumbosacral strain. Countless attempts have been made to correlate lumbosacral structural defects with clinical low back behavior (and nearly as many studies have denied any such correlation). Rupture of the intervertebral disc has flashed across the scene and gradually settled into its slot as another cause of a modest percentage of back trouble.

The fruitless search for a single key to fit every low back problem has led to medical fadism. Each new concept gathers converts who soon become enthusiasts and presently lose sight of the fundamental truth that low back ache is a brew of many ingredients blended in varying proportions in each individual case.

Reproduced in the Table is an outline of the common ingredients of musculoskeletal low back pain. Excluded from this etiological checklist are referred back pain from intra-abdominal or pelvic sources and the spectrum of psychosomatic back aches. No patient with low back pain can be said to have been properly evaluated until each item on the list has been investigated by appropriate methods of examination. Most cases of back ache will be a mixture of etiological ingredients.

The outline is reproduced to establish two points. First, attractive as a new concept of low back pain may be, it is wise not to become enthusiastic to the point of blindness

Low Back Pain: Etiological Check List

I. Structural defects
  A. Segmentation defects
    1. Six lumbar vertebrae
    2. Four lumbar vertebrae
    3. Transitional lumbosacral junction
  B. Ossification defects
    1. Spina bifida
    2. Spondylolysis
    3. Spondylolisthesis
  C. Facet abnormalities
    1. Asymmetry (tropism)
    2. Anteroposterior lumbosacral facets
  D. Increased lumbosacral angle
II. Funtional defects
  A. Lateral imbalance (leg length discrepancy, scoliosis, work or postural attitudes, etc.)
  B. Anteroposterior imbalance (pregnancy, pot belly, flexion contracture hips and knees, etc.)
III. Infections
  A. Bone and joint
    1. Arthritis
    2. Tuberculosis
    3. Brucellosis
    4. Osteomyelitis
  B. Soft Tissue
    1. "Myositis"
    2. "Fibrositis"
IV. Degenerative processes
  A. Osteoarthritis
  B. Senile osteoporosis
  C. Degenerated disc disease
V. Neoplastic processes
  A. Primary
    1. Multiple myeloma
    2. Hemangioma
    3. Giant-cell tumor, eosinophilic granuloma, osteogenic sarcoma
  B. Metastatic
    1. Prostate and breast
    2. Lung, kidney, thyroid, gastrointestinal tract
VI. Traumatic
  A. Compression fracture
  B. Vertebral process fracture (facet, transverse and spinous process)
  C. Sprain and strain
  D. Ruptured disc

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Presented at the Forty-Fifth Annual Meeting of the Industrial Medical Association, Rochester, New York, April 28, 1960.

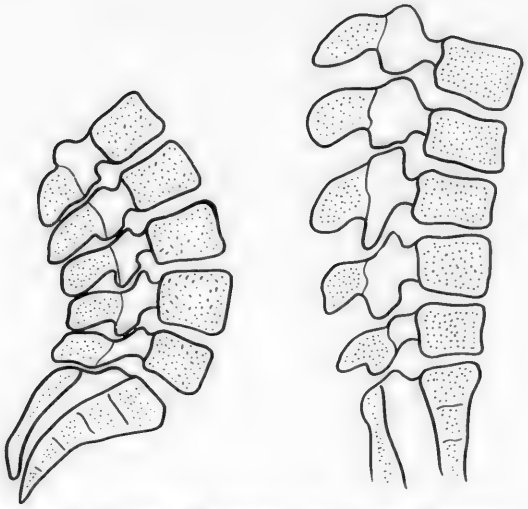

Fig. 1—Tracing of lateral view x-ray of lumbosacral spine showing flexion-extension range.

to other well-established causes of back ache. Second, if the industrial preemployment examination is to yield a meaningful opinion as to how a given back will behave under working stress, it must include an inventory of all the knowable ingredients of back trouble and avoid the error of attempting to correlate a single ingredient, such as the structural peculiarities of the lumbosacral junction, with the clinical behavior of the back. It is entirely possible that a back with a severe degree of spondylolisthesis in a well-muscled man of normal weight with a relatively horizontal lumbosacral angle and no evidence of arthritic tendency or premature degenerative change may function well under heavy stress. On the other hand, a minor spina bifida occulta in a flabby, potbellied man with a leg length discrepancy and a heritage of early musculoskeletal degenerative change may mean trouble.

Despite warnings against overenthusiasm, it is difficult not to be strongly attracted by a relatively new theory to explain the pathomechanics of recurrent acute low back pain on the basis of degenerative and attritional changes in the intervertebral disc.

The concept of degenerative disc disease is well backed by basic anatomical, physiological, and pathological data and seems not only to offer the most rational present explanation for common recurrent acute low back pain but also to lead to the most effective treatment. The theory is based upon an updated concept of the function of the intervertebral disc and upon modern ideas concerning the effects of age and attrition upon avascular musculoskeletal tissue.

First, as to the function of the intervertebral disc. As seen in Fig. 1, the lumbar spine normally moves through a flexion-extension range from a point in forward bending which just reverses the normal lumbar lordosis to a point in backward bending at which the spinous processes impinge. This considerable range of motion must be accomplished without fore and aft shift of one vertebra upon another because of the vulnerable anatomical position of the spinal cord and nerve roots.

The ligaments, whose normal function it is to stabilize moving parts, are present in abun-

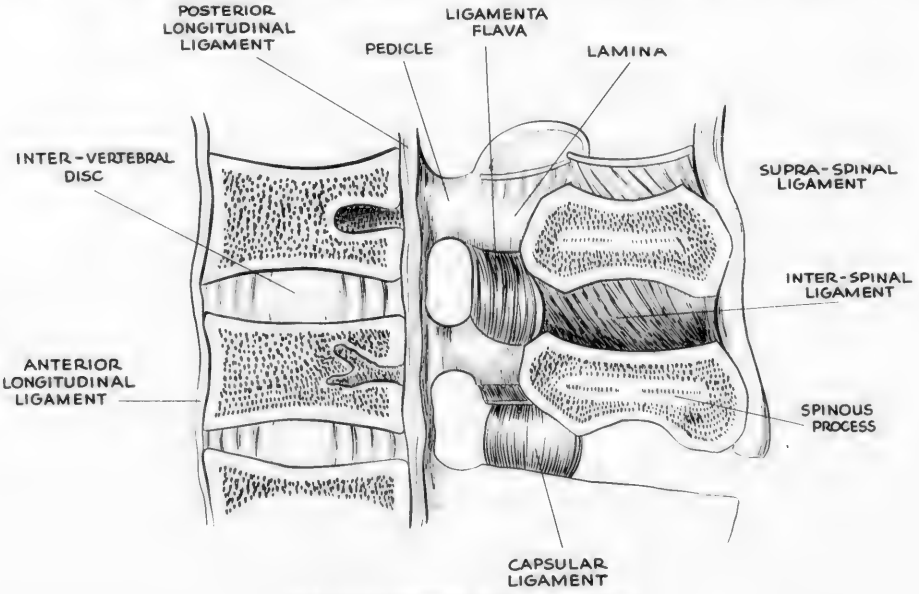

Fig. 2—Ligaments of lumbar spine.

dance in the lumbar region as Fig. 2, based upon a drawing in "Gray's Anatomy," indicates. It is obvious, however, that if these ligaments are tight enough to prevent fore and aft slip of one vertebral segment upon another, there could not be the flexion-extension range of motion which is known to be present.

The answer lies in a positive-pressure device inserted between each of the vertebral bodies and acting like a coiled spring to keep the vertebrae pried apart to the full extent allowed by the ligaments in every position of the spine. The intervertebral disc is this positive-pressure internal stabilizer.

The outer casing of the disc, the annulus fibrosis, is firmly attached to the adjoining vertebral bodies by spiral fibers. The inner packing of the disc, the nucleus pulposus, is, in youth, a gel under significant positive pressure. It constantly pushes the adjoining vertebrae apart to the limits allowed by the spiral fibers of the casing and the strong anterior and posterior longitudinal ligaments, regardless of the position of the spine, and thus maintains the all-important alignment and prevents forward and backward slipping of one vertebra upon another.

Long regarded as a simple shock absorber, the disc now emerges as the most important stabilizer of the spine. Fig. 3 is a schematic presentation of this function and shows the relationship of the stabilizing disc to the neural foramen and the nerve root.

Utilization of the theory of degenerative disc disease in explaining the pathomechanics of low back pain and in deriving methods of treatment depends also upon concepts of age changes in musculoskeletal tissue which are now well established. It is now agreed that the changes of age and attrition in connective tissue begin at about 25. Experience with the rotator cuff tendons of the shoulder teaches further that avascular connective tissue cannot repair itself and increments of day-to-day damage become cumulative. The casing of the disc, the annulus fibrosis, is essentially avascular and shows the same cumulative attritional changes as any other avascular fibrous tissue.

Because of the normal lumbar lordosis, mechanical stress in the low back region falls primarily on the posterior segment of the annulus fibrosis at the fourth and fifth lumbar levels. Throughout the active years, hundreds of injuries, large and small, produce big and little tears of the fibrous tissue of the disc casing in this posterior arc and, like the damage to the casing of an automobile tire, the results are cumulative.

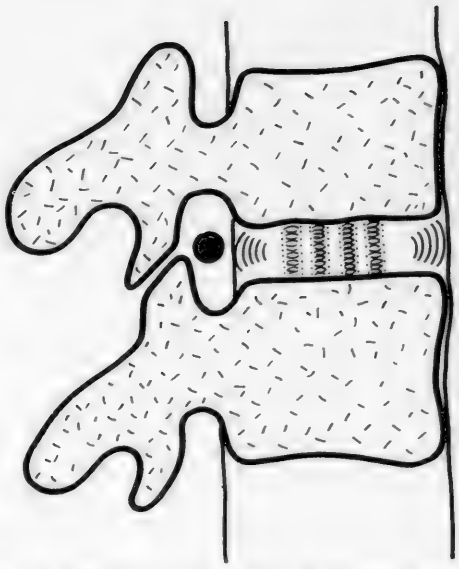

Fig. 3—Schematic presentation of stabilizing function of disc.

If enough tears occur in a limited segment, the result may be either a slow leak or a blowout depending upon the nature of the final traumatic insult, the general condition of the casing, and the pressure of gel inside the casing.

If a blowout occurs, the classical picture of ruptured and protruded disc results as the pressurized gel squirts out of the casing and impinges the nerve root in its bony port hole. Much more frequently, however, only a slow or intermittent leak occurs, and the result is intermittent low back ache without sciatic radiation, usually diagnosed as lumbosacral strain, lumbago, or myositis.

As leakage occurs, the positive pressure in the gel packing is lost and, with it, the all-important coiled spring stabilizing function of the disc. The intervertebral space narrows, the neural foramen becomes smaller and distorted, and, because of the tilt of the facet joints, the superior vertebra settles backward as well as downward on the inferior vertebra. As shown in Fig. 4, this "settle-back," or reverse spondylolisthesis, further narrows the nerve root port.

Its margin of safety within the bony foramen already reduced to the danger point, the nerve root is dealt the final blow by the fore and aft shift of the superior vertebra on the inferior, which is now allowed to occur in flexion and extension of the trunk.

With flexion, the foramen is widened as the upper body slips forward. With extension, however, the upper body slips backward on the

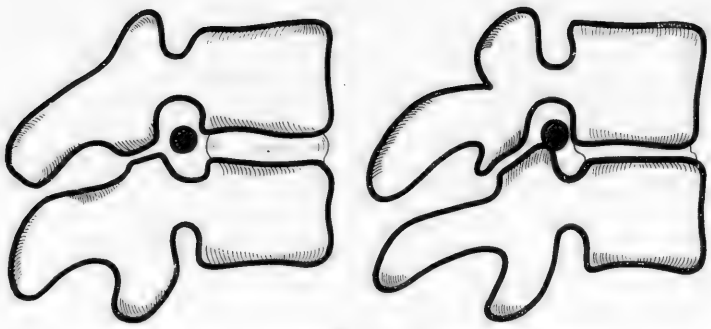

Fig. 4—Degenerative disc disease. Left: normal relationship of disc, neural foramen, and nerve root. Right: degenerated disc with narrowing of interspace, distortion of neural foramen and "reverse spondylolisthesis."

lower as soon as the erector spinae muscles contract and the nerve root may well be pinched. If, in addition to countering the gravity pull of the forward flexed trunk, the muscles must also lift a load, the backward thrust of superior on inferior vertebra may be severe. If, during lifting of the load, a twisting motion of the trunk is demanded, the nerve root on the side toward which the twist occurs may take intolerable pressure.

There is reason to believe that a pinched nerve root and its surrounding insulating fibrofatty tissue within the bony foramen will swell, thus further reducing the already dangerously low margin of safety and setting the stage for further attacks of pain following ridiculously minor trauma.

When a significant nerve root pinch has occurred, a physiological entity known as the pain-spasm reflex enters the picture. Since the pain-spasm reflex is usually the dominant clinical feature of the early stages of the attack, since it tends to prolong and intensify nerve root pressure, and since it may persist as the proximate cause of continued disability long after the pressure has gone off the nerve root, it becomes vital to understand the mechanism of this entity.

Many painful stimuli throughout the body provoke muscle spasm, a common and usually efficient protective mechanism. Nerve root pressure in degenerative disc disease is a potent stimulus of spasm in the thick paraspinal muscles. Maximum contraction, or spasm, of such thick muscles as these, if long continued, produces ischemia of muscle substance by a sort of tourniquet effect. Blood vessels to some fibers of the muscle are mechanically clamped off as they pass between other fibers locked in tight spasm. Chemical products of muscle metabolism pile up in the absence of adequate blood supply and produce pain. This pain, misinterpreted by the cerebral integrative center as a failure of the protective device, evokes more spasm and the pain-spasm cycle is born.

Since all of the back muscles invoked in the spasm response are longitudinal, a clamping down of the two vertebra adjoining the degenerated disc results and the much-belabored nerve root is again in the squeeze.

The pain-spasm reflex is self-perpetuating until the involved muscles become so fatigued as to be unable to obey motor nerve impulses. It may thus persist as the proximate cause of total disability long after the initiating painful stimulus has ceased.

The almost universally advised application of local heat to a painful low back with pain-spasm reflex may actually increase pain and spasm. Heat increases the rate of muscle metabolism in the face of an existing deficit in blood supply, augments the production of pain-producing metabolites, and thus actually prolongs the reflex.

From the above concepts of degenerative disc disease and the pain-spasm cycle, all the usual features in the clinical picture of common intermittent low back pain can be construed and satisfactory therapeutic measures can be derived.

Patients with degenerative disc disease are predominantly male and range in age from the late twenties to the early fifties. Usually, they are first seen in an acute attack, featured by sudden onset of severe, disabling low back pain following an unguarded move or unusual activity involving extension and torsion of the trunk. They may or may not have radiating pain into the buttock or in the sciatic distribution. Neurological symptoms of coldness or pins-and-needles sensation in the foot or leg, weakness of the leg, and aggravation of pain by coughing, sneezing, or straining at stool are similarly variable. There is almost always a past history of previous similar attacks with intervening periods of complete freedom from symptoms on full normal activity. Early attacks feature back pain only. Later attacks may be accompanied by radiation of pain, first into the buttock and finally down the leg. The frequency and duration of the attacks tend to increase over the years.

Patients tend to seek low Fowler's position for comfort; hyperextension of the trunk with full extension of the legs increases the pain. They usually are unable to sleep on the stom-

ach. They may have derived relief in past episodes from chiropractic or osteopathic manipulation.

On examination, there is usually obliteration of the normal lumbar lordosis and a list of the trunk forward and away from the painful side accompanied by severe muscle spasm. Back motions are usually grossly restricted in all planes, but hyperextension and lateral flexion toward the painful side are violently resisted. Maximum tenderness may be over buttock, sacroiliac joint or lumbosacral joint, but frequently the entire pain pattern can be reproduced by shock percussion over the fourth or fifth lumbar vertebra about 1 inch lateral to the midline on the painful side. Straight leg raising is severely restricted on the painful side, less markedly so on the other side. Knee-to-chest position is comfortable and actually relieves the pain.

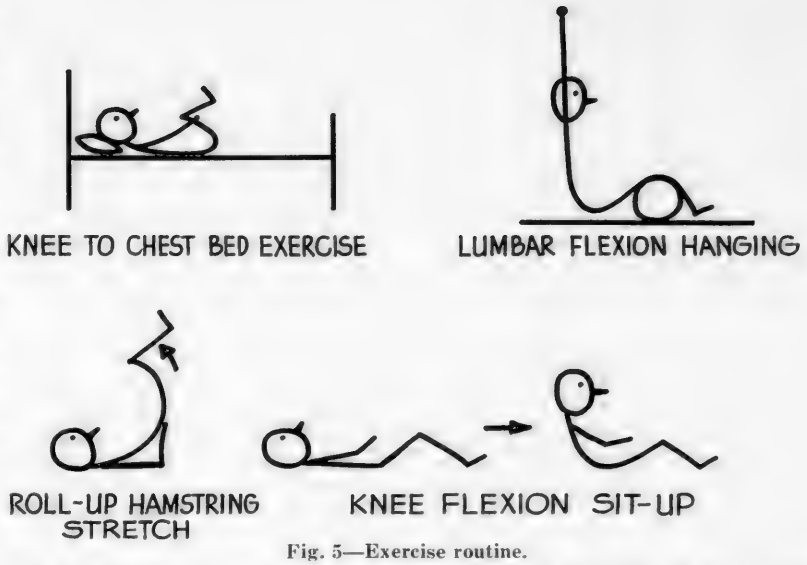

Fig. 5—Exercise routine.

Neurological findings vary with the amount of nerve root compression and may be normal or may show evidence of gross pressure. Earliest signs of nerve root compression are diminution of the ankle jerk as tested in the kneeling position and minor loss of power of dorsiflexion of the great toe.

Roentgenograms show a variable amount of narrowing of the fourth or fifth lumbar disc space with a "settle-back" of superior on inferior vertebra at this level, evidence of facet joint subluxation, neural foramen narrowing, and bony productive changes (sclerosis and spur formation) of the adjoining margins of the vertebrae. In early attacks, the x-ray pictures may be normal. It is known that very extensive degeneration of the disc must occur before the first x-ray evidence of the condition is detectable.

Methods of treatment are derived directly from the pathomechanics of the degenerative disc process. Given a patient of reasonable intelligence, the most helpful therapy for the long haul is a complete explanation of degenerative disc disease. This takes time, but it is always well received and, being essentially mechanical in derivation, is usually well understood. Once in possession of a workable knowledge of the nature and mechanical behavior of his disease, the patient can better reason out for himself general methods of care, can understand which activities he must restrict, and can often handle future attacks on his own.

If the patient is in the pain-spasm cycle when first seen, there is no alternative or substitute for absolute bed rest in low Fowler's position. He should be given adequate analgesia to break the sensory side of the reflex and one of the antispasm medications to interrupt the motor arc. He should be warned against the use of local heat and prepared for a period of total incapacity in bed of at least three days and as long as three weeks.

As the pain-spasm cycle fades, the program of long-term care can be taught. Essentially, this program is aimed at achieving and maintaining flexion of the lumbar spine so as to widen the neural foramina and prevent recurrent nerve root pinch. This objective is attained by exercises designed to strengthen the abdominal and gluteal muscles and stretch the hamstrings and by painstaking and detailed instructions to the patient in standing, sitting, and sleeping posture.

While the patient is still in bed, knee-to-chest exercises (Fig. 5) are begun. With early ambulation, lumbar-flexion hanging is frequently helpful. Later, knee-flexion sit-ups and roll-up hamstrings stretchings are instituted and must be carried on daily. The entire exercise program can be carried out in about two minutes, and the patient is encouraged to do his exercises just as soon as he is out of bed in the morning as automatically as he shaves or brushes his teeth.

The patient is taught to maintain lumbar flexion at all times—at work and at home;

standing, sitting, or lying; awake or asleep. Herein lies his salvation.

Flexion of the lumbar segment is achieved in part by slight forward inclination of the upper trunk ("dynamic posture"), but more importantly by tilting the pelvis in such a way that the buttocks are drawn in under and the symphysis pubis more closely approximates the umbilicus. In sitting, the knees should be higher than the hips. Car seats should be moved forward and, if necessary, tilted back. Seat safety belts help to maintain lumbar flexion when driving by holding the pelvis in the favorable tilted or flexed position.

The obese must lose weight—especially the potbellied obese—to keep the pot from dragging the lumbosacral area into hyperextension. Loads must be lifted close to the body to avoid the lever arm action, always with a flat back, and never above waist level. If it is necessary to turn with a load, the turning should be done by shifting the position of the feet, not by twisting the trunk.

Long periods of standing are less likely to produce hyperextension sag and back pain if one foot is put on a low stool or platform. This method of producing pelvic flexion is particularly helpful to the housewife patient in getting through the week's ironing. Experts have speculated that the comfort gained during long periods of standing by this method of pelvic flexion probably dictated the design and placement of the bar rail in the old-fashioned saloon.

Corsets and belts may be temporarily necessary in some patients. Their design should be such as to maintain flexion.

Medication to hasten the subsidence of the perineural swelling which attends mechanical impingement is frequently used during the recovery period. Simple salicylates are most useful. Local heat is safe during the recovery period after the pain-spasm cycle has abated.

Sooner or later, the patient will have another attack. He should be provided with a supply of antispasm medication for instant use at the first warning twinge of muscle spasm. Such medications, if used very early and in adequate dosage, can abort a significant number of acute attacks.

A certain small percentage of patients with degenerative disc disease will sooner or later encounter unrelenting nerve root pressure which cannot be relieved by conservative management. They will require surgical intervention to decompress the nerve root.

If the patient can avoid the severe and unrelenting nerve root pressure requiring surgical decompression, he will ultimately lose his back pain and regain stability between the two vertebrae adjoining the degenerated disc. This happy ending occurs when sufficient fibrous tissue is laid down across the space formerly occupied by the nucleus to produce a scar tissue body-to-body bond between the vertebrae. In effect, the spring-like stability of youth, dependent upon the positive pressure of the compressed-gel nucleus, is at last traded for the more rigid scar stability of age.

The patient should be made aware of this favorable long-term prognosis in degenerative disc disease. His long period of intermittent back pain then becomes bearable as a withholding battle in which ultimate victory is virtually assured rather than a life sentence of recurrent misery ending only in the grave.

(The author's address is 277 Alexander St., Rochester 7, N. Y.)

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The Toxicology of Organometallic Compounds—Part II

Charles E. Lewis, M.D., Sc.D., Longview, Tex.

IN PART I of this presentation the properties and toxicological actions of the organometallic compounds derived from the metals comprising Groups I through IV of the periodic table were discussed. In this concluding section similar discussions will be presented for the remainder of the metals. Two special types or classes of organometallic substances—the metal cyclopentadienyl and metallic carbonyl compounds—will be reviewed separately.

The Organometallic Compounds of Group V

The organic compounds of arsenic, antimony, and bismuth have been of considerable interest because of the early work of Ehrlich. Their subsequent use in the treatment of spirochetal diseases in the early part of the 20th century is one of the milestones in medicine.

Arsenic—Introduction into the body of organic arsenical compounds produces a qualitatively different effect than does the absorption of an equivalent amount of inorganic arsenic. Organic arsenicals show little of the paralyzing effect on capillaries that is so characteristic of the inorganic arsenic compounds. With the passage of time and biochemical reactions, free arsenic is gradually liberated. This produces the usual actions of inorganic arsenic in a delayed and usually milder form.

Antimony—Trimethyl and triethyl antimony compounds inflame on contact with air. Higher members of this series are stable compounds. The difference in the metabolism and toxic effects produced by organic and inorganic antimony compounds is much less than for most of the other organometallic agents. Both classes of antimony compounds are excreted very rapidly after their absorption, primarily in the urine. Like arsenic, the trivalent antimony compounds are generally more toxic than the pentavalent. Most of the organic antimonials in common use involve metal-oxygen-carbon linkages and as such do not fall into the organometallic classification as originally defined. Trimethyl antimony is far less toxic than ordinary antimony compounds. It produces a fall in blood pressure. Large doses depress central nervous system functions but do not produce encephalopathy, as do the trimethyl derivatives of bismuth, lead, and tin.[13]

Bismuth—It is difficult to compare the relative metabolism and excretion of organic and inorganic bismuth compounds, owing to the lack of information on the former. Toxic doses of inorganic bismuth salts produce a fall in blood pressure, which, if not fatal, is followed by death due to renal failure in a few days. Trimethyl bismuth is rapidly absorbed through the intact skin. It produces inflammation of the skin or mucous membranes on contact and causes a gradual fall of blood pressure.[14] In contrast to inorganic bismuth, however, trimethyl bismuth produces narcosis and central nervous system depression. Repeated administration of sublethal doses results in a marked encephalopathy similar to that found in organic lead or inorganic tin poisoning.[11]

The Compounds of Groups VI and VII

Selenium alkyl and aryl compounds, like their inorganic counterparts, are extremely odoriferous. The alkyl compounds are colorless liquids, and the aryl derivatives are solids. Similar compounds of tellurium undergo rapid oxidation upon contact with air.

The Organometallic Compounds of the Transition Elements

Transition elements are characterized by atoms having an outer shell of electrons con-

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taining from 8 to 18 electrons. Most of the combinations of transitional elements with alkyl or aryl radicals are productive of compounds which are unstable in the presence of either moisture or air. It has been impossible to isolate a large number of these compounds. No compounds involving tungsten or molybdenum are known except their cyclopentadienyl derivatives. Cobalt and nickel form a few classical organic compounds. Platinum has formed several stable compounds, such as trimethyl platinum.

The straight combinations involving a classical carbon to metal bond are not commonly found, or of toxicological importance, in the case of the transitional metals. There is another class of transitional metal compounds which is of considerable interest and will be discussed in the following section.

The Cyclopentadienyl Compounds— One of the recent major advances in the field of chemistry came in the early 1950's, when an entirely new type of chemical bond was recognized. In 1951, Kealy and Paulson found that iron reacted with cyclopentadiene to produce an organometallic compound of unusual stability.[15] Since that time, numerous compounds involving the transitional metals have been isolated which have a similar structure. This has been referred to by some as a "sandwich" structure. The feature of this class of compounds is the symmetrical binding of the central metal atom to all five carbon atoms of each ring so that only a π bond links the metal to each ring (Fig. 2). The structure cannot be properly described in classical valency bond terminology.

Certain of these compounds have already been suggested as having future commercial importance. Ferrocene is reported as reducing carbon deposition and smoke formation when added to fuel oil. A manganese compound of this type has been of interest as an antiknock agent.[16]

The iron cyclopentadienyl compound (ferrocene) is quite stable. Many of the other combinations of this type involving transitional metals, such as cobalt and nickel, are productive of compounds which are oxidized in air but whose salts are stable. The chromium compounds are very sensitive to oxygen, and the cation is quite unstable in water. Vanadium compounds of this type have been isolated. Tantalum, molybdenum, and tungsten compounds have similarly been prepared. Rare earth compounds of this type have been isolated. These involve three cyclopentadiene rings in a (presumably) similar type of bonding.

While ferrocene is of limited solubility, it is

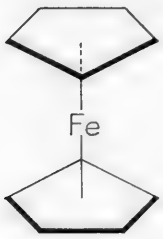

Figure 2.

possible to introduce solubilizing groups on either ring and produce compounds of quite different physical properties. This will also alter the basic stability of the entire structure and its chemical activity. An alpha amino acid with the ferrocene group, which may be regarded as an analog of phenylalanine, has recently been synthesized.[17] The uses of a compound such as this in pharmacological investigation are apparent. By proper substitution on the ring, it should be possible to alter the physical properties so that a suitable lipid/water soluble ratio could be attained in a compound of only moderate chemical reactivity. It should be possible to introduce iron compounds of this sort into the body, past the normal protective barrier of the apoferritin system. Subsequent metabolism of the molecule could result in tissue release of iron (or other cations). It might be possible to introduce varying quantities of cations for purposes of therapy or investigation. These might be concentrated in certain tissues, depending on the properties of the compound.

A review of the literature has revealed no information on the toxicity, the biochemical reactions, or the metabolism of the biscyclopentadienyl metal compounds.

Derivatives of this class of compounds are the cyclopentadiene-metal carbonyls. In this group, one of the cyclopentadiene rings is replaced by varying numbers of carbonyl (C=O) groups. Manganese, molybdenum, tungsten, cobalt, and vanadium compounds of this sort have already been reported. These compounds are made by the reaction of carbon monoxide and metal—cyclopentadiene, or cyclopentadiene plus a metallic carbonyl.

Metal Carbonyls—The combinations involving transitional metals and carbon monoxide are usually not considered as organometallic compounds, although their structures do involve covalent bonds between the metal and carbon atom. They resemble covalent organometallic compounds in that they are usually volatile liquids or solids with low melting points. They are usually soluble in organic solvents and

insoluble in water. Their reactivity is relatively high and the CO group is easily replaced by CN^-, halogens or NO^- groups. Compounds of most of the transitional metals are possible. The toxicities of iron, nickel, and cobalt carbonyls have been studied.

Nickel carbonyl has had widespread use since the original discovery of its use in the refining of nickel. Inhalation of nickel carbonyl in toxic quantities is followed by headache, vomiting, nausea, and epigastric pain. After a latent period, which may range up to 24 hours, the exposed subject may experience the onset of pulmonary edema, with evidence of cyanosis, dyspnea, fever, and a sensation of substernal constriction. The nickel is excreted in increased quantities in the urine, without a concomitant increase in fecal nickel excretion. Almost all the nickel which has been absorbed in a single exposure is excreted by the sixth day.[18]

CASE 4—A 26-year-old operator was exposed to nickel carbonyl at 10 a.m. He complained of headache, dizziness, and nausea, and vomited once. After a four-hour period of rest and observation, he felt well enough to go home. He complained only of a headache at that time. At 11 p.m. he experienced the gradual onset of shortness of breath and marked weakness. He had a feeling of retrosternal pressure and became nauseated. On admission to a hospital at 1 a.m. he was cyanotic and had a pulse rate of 120 minute and an oral temperature of 100° F. He was found to have pulmonary edema, and administration of oxygen by positive pressure was begun. His condition remained essentially unchanged for the next 24 hours. He subsequently made a slow recovery over a period of two months.

Studies of the metabolism of inorganic nickel compounds have shown that, after the administration of nickel chloride intraperitoneally to mice, most of the nickel was excreted in the feces. The pathologic changes produced by nickel carbonyl were essentially those found following intravenous administration of inorganic nickel. The most significant of these was the diffuse injury of capillaries. It is not known whether nickel carbonyl is absorbed into the body as such or whether dissociation and liberation of ionic nickel occurs in the lung with subsequent injury to the pulmonary alveoli and capillary network.

Cobalt carbonyl has found less use in industry. While no chronic studies have appeared on this material, it would seem that its acute toxicity is less than that of nickel carbonyl. Kincaid and his colleagues have administered as much as 130 mg/kg of the $Co_2(CO)_8$ compound to mice without any observed effects.[19]

Iron pentacarbonyl is a volatile yellow-red liquid which is oxidized spontaneously on exposure to air. Armit found that 0.025 vol. % of iron pentacarbonyl inhaled for 45 minutes was lethal to rabbits.[20] Pathologic changes were similar to those found following exposure to nickel carbonyl. A recent study of this material has indicated that it was toxic (LD_{50} = 2.19 mg/liter for rats and 0.91 mg/liter for mice) to rats and mice in acute inhalation studies.[21]

Safety Problems in Handling and Transporting

In certain groups (I, II) of these compounds, the major problem is the safety aspects of material transfers. Since many of these compounds oxidize violently upon contact with air, or hydrolyze in water with equal vigor, it is necessary to handle them under dry nitrogen or another inert dry atmosphere. The technique of vacuum manipulation is probably the best for those substances that are spontaneously inflammable and volatile.

The disposal of certain of these compounds may also prove a problem. Nonvolatile and nonreactive compounds may be disposed of by boiling small (milligram) quantities of them in a hood with nitric acid (alkyl mercury compounds). Larger quantities of reactive compounds, such as the alkyl compounds of Groups I and II, may be treated with alcohol, preferably alcohol diluted with a hydrocarbon solvent, and burned in an isolated disposal burning area.

Compounds which are highly volatile, especially if they are toxic or spontaneously inflammable, pose the greatest problem. A suggested method for disposing of these compounds is to remove the container to a remote spot out-of-doors and from a safe distance upwind puncture it with a rifle bullet.

Summary

There is very little information available on the toxicological properties of organometallic compounds. Only those which have been of commercial or pharmacological interest have been studied.

Many compounds are so chemically reactive that they oxidize and/or hydrolize violently on contact with air or water. The toxic hazards of these are less important than the safety aspects of their handling. The decomposition products of such organometallic compounds (metal and hydrocarbon) may be toxic and should be considered.

The more stable organometallic compounds may be absorbed into the body, especially

through the intact skin. The subsequent metabolism of such compounds is usually quite different from that observed for the constituent inorganic metallic ion. Their ultimate effects may be dependent upon their distribution and concentration in the tissues and the rate at which metallic ions are released or become capable of molecular interactions.

(The author's address is Texas Eastman Company, Longview, Texas.)

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UCLA Occupational Health Field Trip

Pictured above are graduate students and faculty members on a field trip which is part of the graduate program in occupational health at the School of Public Health, University of California, Los Angeles. Field trips are conducted to local industries on a weekly basis. Information regarding the medical program and plant operations is obtained from the Medical Director and plant management personnel. The group in the photograph is shown at lunch in the Commissary during a field trip to the Paramount Studio, Hollywood. From left to right are: Mrs. Barbara Olson; Mrs. C. John Rozas; C. John Rozas; Leon J. Warshaw, M.D., Chief Medical Director, Paramount Pictures Corporation (New York City); Hugh J. Strathearn, M.D., Medical Director, Paramount Pictures Corporation (Hollywood); Robert Cole; Charles E. Schoettlein, M.D.; J. S. Felton, M.D.; and Kenneth Callister, M.D.

Industrial Medical Aspects of Nuclear Technology

IV. BIOLOGICAL EFFECTS OF RADIATION AT THE MOLECULAR LEVEL

Albert A. Spritzer, M.D., and Niel Wald, M.D., Pittsburgh, Pa.

BEGINNING with this fourth article in the series of reviews of various aspects of nuclear technology which are of importance to the industrial physician, we shall embark on a consideration of the biological effects of radiation. The understanding of hazard to or treatment of an employee exposed to ionizing radiation must stem from a grasp of the fundamental radiobiological phenomena which will be dealt with in this and the next several articles in this series. As a starting point, we will review briefly certain basic general radiobiological concepts which are important in the consideration of molecular and biochemical changes induced by radiation. No attempt will be made to review the experimental data upon which these concepts rest, and the references are limited to general treatises in which more detailed information and specific references are given.

Radiation Interaction with Matter

The third article of this series dealt in some detail with the primary modes by which radiation interacts with all matter. These types of primary interactions of ionizing radiations are partially summarized as follows:

Gamma radiation and x-rays
- (a) Photoelectric effect
- (b) Compton effect
- (c) Pair production

Beta radiation (electrons)
- (a) Bremsstrahlung (x-rays)
- (b) Ionization
- (c) Excitation

Alpha radiation
- (a) Ionization
- (b) Excitation

Neutrons
- (a) Elastic collisions
- (b) Inelastic collisions
- (c) Radiative capture
- (d) Other nuclear reactions

If one considers the individual modes of interaction and follows the sequelae of such interaction with matter, then it could be shown that either initially or ultimately excitation or ionization of atoms is produced. For example, in the photoelectric effect, a radiation photon imparts its energy to an orbital electron and this electron is ejected from the atom (primary ionization) and, in turn, may dissipate its energy by ionizing or exciting other atoms. In the case of a neutron that interacts by colliding with a hydrogen nucleus of a water molecule, the hydrogen nucleus is ejected from the molecule (recoil proton) and quickly loses its energy by ionizing or exciting neighboring atoms. A similar sequence of events leading to ionization or excitation could be constructed for the other modes by which radiation interacts with matter. Of course, the energy which is dissipated in tissue by radiations and which is basically responsible for any biochemical effect, is ultimately degraded to heat. However, a simple calculation shows that it would take a dose of 100,000 r to raise the temperature of tissue by 0.25° C. This indicates that a diffuse heating effect in tissue could not account for the marked radiation effects produced by much lower doses of radiation. To generalize then, radiation interacts with tissue to produce ionization and excitation of atoms, which, in turn, results in biochemical changes.

Excitation

Electronic excitation is a mode of energy absorption in which the orbital electronic con-

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figuration of an atom is changed. One can speak of electrons being elevated to higher energy states. The excited atom has a tendency to rid itself of this excess energy in a number of ways. One method by which atoms return to "ground state" is the emission of the excess energy as photons of electromagnetic radiation. The cherry-red color of heated iron is an example of this. An alternative method of releasing the excess energy is to impart it directly to another atom. In this case, if the energy is sufficient, ionization of the second atom may take place. If an excited atom happens to be part of a molecule, the change in its electronic configuration will influence its valence electrons. By this mechanism intramolecular bonds may be ruptured or distorted.

For the outermost electrons of an atom, the excitation energies range somewhere between 3 and 25 ev. These excitation energies increase appreciably with electron states nearer to the nucleus. Since the atomic bonds in molecules usually have bonding energies of less than 10 ev., it is obvious that excitation energies can disrupt intramolecular bonds.

Ionization

Ionization is considered the most important mechanism for producing radiochemical effects. It involves the loss of an orbital electron of an atom, resulting in an "ion pair" consisting of a free electron and a positively charged atomic residual. The importance of ionization lies in its ability to disrupt intramolecular bonds. The energy necessary to rupture a carbon-hydrogen bond is approximately 4 ev. When radiant energy is dissipated by ionization, approximately 32.5 ev. are expended. Since this average value greatly exceeds the ionization potential, the resultant surplus energy has a high probability of effecting additional bond ruptures. However, it must not be assumed that all ionizations produce molecular dissociation. In larger molecules, such as proteins, spatial and other forms of organization exist which tend to preserve the molecule. It is possible, perhaps even probable, that the bond defects produced by ionization are quickly reversed to normal. In some instances, such as chromosomal breaks, single ionizations are ineffective, and multiple, almost simultaneous, and closely proximate ionizations are necessary to produce this effect.

Ionization Versus Excitation

How important is excitation as compared to ionization in producing radiochemical effects? Since the properties of excited and ionized atoms are to a large extent unknown, the question cannot be answered. We do not even know what proportion of the radiation energy is expended in excitation rather than ionization in tissue. It is highly doubtful that the estimates derived from studies of simple gases can be applied to tissue. Some investigations have been made to compare the effects of ultraviolet (UV) light, which results predominantly in excitation, with those of ionizing radiation. These studies indicate a greater effectiveness of ionizing radiation in producing specific biochemical changes. However, since UV absorption depends on molecular properties while ionizing radiation absorption depends on atomic characteristics, strict comparison between the two types of radiation is difficult when irradiating a complex substrate. In most discussions of biological effects of radiation, excitation is ignored and primary radiochemical effects are considered to stem from ionization alone. This may be the result of our greater ability to detect and measure ionization.

Ionizing Characteristics of Various Radiations

It is well known that different types of radiation have different degrees of efficiency in producing specific biochemical changes. For example, alpha and beta rays are much more effective than gamma rays in causing chromosomal breaks. If one considers virus inactivation, gamma rays are much more effective than alpha or beta rays. This variation in the ability of different types of radiation to produce specific biochemical changes is described by the term "relative biologic effectiveness" (R.B.E.). Partial explanation for these differences in effect may be found by studying the patterns of ionization produced in tissue by the different types of radiation.

Consider gamma rays. These are very penetrating. It is not unusual for a gamma ray to pass through a body of matter without interacting at all. If we could visualize the linear track of a beam of gamma rays passing through some tissue, we would see sporadic ionizations occurring at relatively widely spaced intervals (Fig. 1*A*). In the case of x-rays, which are less energetic or "softer" than gamma rays, interaction with the tissue is more probable. Another way of saying this is that softer x-rays are more readily absorbed by tissue. The track of one such beam would show more ionizations occurring at shorter intervals (Fig. 1*B*). Beta rays consist of electrons, and because of the charge of each particle we might expect that such a particle would have a high probability of being influenced by and interacting with the charged atomic electrons and nuclei. In

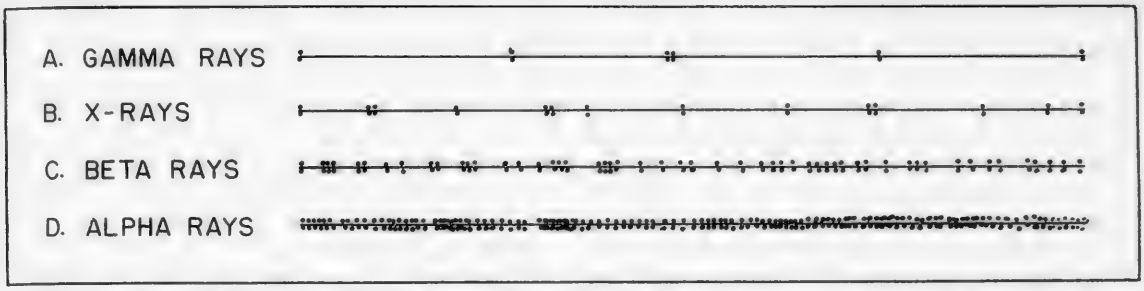

Fig. 1—Density of ion pair formation by (A) gamma rays, (B) x-rays, (C) beta rays, and (D) alpha rays.

actual fact, a beam of beta rays is completely absorbed in a few centimeters of tissue, and its visualized track would show a high density of ionization in tissue (Fig. 1*C*). In a like manner, the even more strongly charged alpha particle with two positive charges would cause an extremely high ionization density and thus rapidly loss energy and be quickly absorbed in a few microns of tissue (Fig. 1*D*).

When we consider a neutron beam, the case becomes more complicated. We know that neutrons are very penetrating. Therefore, interactions would occur at widely spaced intervals. However, the neutron may interact by ejecting an atomic nucleus from an atom and this highly charged mass could then cause an extremely high degree of ionization in a very localized volume of tissue.

The linear spacing of ions produced by radiation is spoken of in terms of "ion density," i.e., the number of ion pairs formed per unit length of track. Since radiant energy is dissipated in producing ions, ion density of radiation gives a general indication of the spatial distribution of energy absorbed by tissue. In the case of gamma radiation, the ion density is low and the energy of such a radiation exposure tends to be widely dispersed throughout the volume of the irradiated tissue. In the case of alpha radiation, which has a high ion density, the energy dissipation in irradiated tissue tends to be very localized. In fact, this localized dissipation of energy may bring a very small volume of tissue to a temperature as high as 100° C. for a very short period of time. The ion density of beta radiation falls in between the ion density of gamma and that of alpha radiation. The concept of ion density is applied to neutron exposures with difficulty because of the wide fluctuations in the number of ionizations produced along the exposure track.

Linear Energy Transfer

Because we are uncertain that ionization rather than excitation is of primary importance in producing radiation effects, a broader term than ion density has been introduced. The linear energy transfer (LET) refers to the energy absorbed by tissue per unit length of a radiation track. It is measured in units of thousands of electron volts per micron of distance (kev/μ). The LET makes no assumption as to how the energy of radiation is dissipated in tissue. The LET has been found to vary approximately as the square of the particle charge. Thus, an alpha particle would have a very much higher LET than an electron.

The LET is an inverse function of the velocity of a particle. This correlates well with the fact that high energy beta particles are more penetrating than slower or less energetic ones. One would expect that the slower-moving beta particle, which spends more time in the vicinity of any given atom, would have a greater chance of interacting with that atom. The inverse rule also correlates well with the fact that a large proportion of the energy dissipation in tissue by charged particles, such as alpha or beta particles, occurs at the tail end of their tracks in the vicinity of their extreme ranges in tissue.

In the case of a beta particle that enters tissue with a high velocity, the LET is initially relatively low. As the electron loses more of its energy and decreases in velocity, the LET increases, i.e., the rate of energy loss per unit length of track rises.

The concept of LET can aid us in understanding, in part at least, the relative efficiences of various types of radiation in producing biochemical changes. Refer again to some protein molecule and its inactivation or denaturation. If we irradiate this protein with alpha rays, beta rays, and gamma rays independently, it would not be unexpected to find that for any amount of energy absorbed by the protein, alpha rays are more effective than beta rays, which, in turn, are more effective than gamma rays in denaturing the molecules. We might reason that, since the protein molecule is a highly ordered structure, a relatively large amount of energy would have to be expended

within the molecule in order to disrupt it. Therefore, the relative biologic efficiency of radiations for this type of effect would correlate well with the LET of the radiation (energy expended per unit path). Suppose, however, that empirically we find that for some specific effect, such as point mutations, as the LET increases the biological effectiveness of the radiation decreases. We might reason that in order to produce this type of biologic change only a small amount of energy is needed. If the energy dissipation is very concentrated (high LET), only a small amount of it is used to produce the biologic effect and the remaining energy dissipated in the neighborhood is ineffective in producing any further change effect. For this type of reaction gamma irradiation with its wide dispersion of energy absorption (low LET) would be most effective.

In general, those biologic effects in which there is a decrease in the efficiency of the radiation with an increase in LET (point mutation, virus inactivation, etc.) would seem to be reactions of a relatively low order of complexity or reactions whose locus is restricted to extremely small volumes. In the more common case where radiation efficiency increases with LET, it is found that intense localized distortions in larger volumes are necessary to produce the radiation effects.

Direct and Indirect Mechanisms

So far we have discussed such basic factors in radiochemical mechanisms as excitation, ionization, and LET (spatial factors). In order to generalize about temporal factors of importance, an understanding of direct and indirect radiochemical mechanisms is necessary.

Since tissue has a water content ranging from 80% to 95% of its weight, it is probable that some radiobiologic effects are produced "indirectly" by ionizing or, in some other way affecting, the water in tissue. Other radiobiologic effects are produced "directly" by ionizing or affecting the molecules of tissues other than water. The relative importance of the "direct" versus the "indirect" effects of radiation is still unsettled but of extreme practical and theoretical importance, as will be shown below.

Target Theory

In considering "direct" mechanisms of action of radiation one can think of events that are produced by a single ionization or a number of ionizations with or without varying degrees of recovery, i.e., reconstitution of the normal molecular or chemical pattern. The simplest class of actions would be those that require a single ionizing event to produce the biologic change and that permit no degree of recovery. It is only for this class of radiochemical events that we have anything approaching a comprehensive theoretical treatment. This theory is sometimes referred to as "single hit theory" and is thought to be applicable to virus inactivation, bacterial killing, and point mutation. For all other classes of direct radiation effects our knowledge is limited and empirical, and the factors that influence recovery are still to be elucidated. In order to illustrate the importance of such a theory as a tool for understanding radiation effects, we will review Lea's approach.

The assumptions of single hit theory are briefly as follows:

1. Ionization is the sole cause of the biologic effect.
2. For an effect to occur only one ionization is necessary.
3. The particular biologic effect is initiated in a definitive critical volume which is a sphere with a definite radius.
4. Any ionization that occurs in this critical volume has a total effect.
5. Any ionization occurring outside the target sphere has no effect.

In a test system in which these assumptions hold for any induced biologic effect, we can predict and explain a number of characteristics of the event.

Consider the effect of varying the time or dose-rate of the irradiation. Since the biologic event is an all-or-none event, no reversal can be expected and recovery would not occur. The quantitative effect of the irradiation would depend solely on the total dose, no matter how that total dose was given in time. Thus, the time, or dose-rate, would have no effect. Contrariwise, if an event depends on the occurrence of many almost simultaneous ionizations, then the distribution of the total dose in time would exert a marked influence on the total number of events that would occur (such as chromosomal breaks) and the degree of recovery therefrom.

The dose-response curve of a single hit event would be either linear (Fig. 2*A*) or exponential (Fig. 2*B*). In the case of gene mutations, where only a very small fraction of the genes are affected by even large radiation doses, each equal radiation dose increment will affect the same number of genes. Doubling the dose doubles the effect, and so the dose response curve is linear. However, in the case of bacterial killing, one can give a dose such that almost all the bacteria are killed. When the culture is

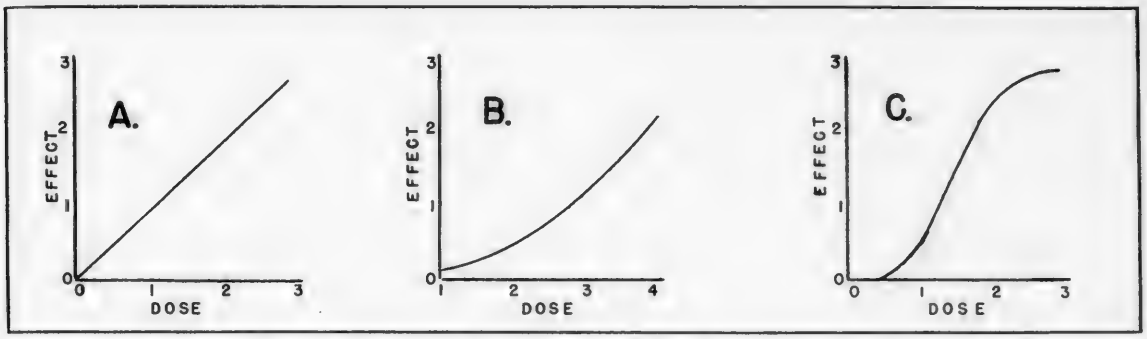

Fig. 2—Types of Dose-Response Curves: (A) linear, (B) exponential, (C) sigmoid.

initially irradiated, for every target "hit" a bacterium is killed. Each successive dose increment kills fewer bacteria because, as the number of killed bacteria increases, a larger proportion of the radiation hits targets in already dead bacteria. When all the bacteria are killed, any additional dose will have no effect whatsoever. Another way of stating this is that for each equal dose increment the number of bacteria killed is proportional to the number of live bacteria present at the start of the dose increment. That is, the survival curve is exponential.

Note that implicit in these two types of dose-response curves is the fact that any dose of irradiation, however small will produce some effect and that there is no "threshold." If the biologic event depends on a number of ionizations with all degrees of recovery possible, then in the simplest case the survival curve (or dose response curve) will have a threshold dose below which no effect is observed. It will be sigmoid in shape because at first only the most sensitive organisms will be affected and finally there will be a group of very resistant organisms.

In the single hit class of biologic events, radiation effectiveness would be greatest with those radiations having the lowest LET and much smaller with radiations having a high LET, as explained previously.

The more complex and more common types of "direct" actions of radiation must be approached individually and empirically until adequate theory has been developed.

Indirect Actions of Radiation

The study of the effect of radiation on water is still in its infancy. It is thought that irradiation of water molecules results in the production of atomic hydrogen (H^+) and hydroxyl (OH^-) radicals and that in the presence of dissolved oxygen peroxides are formed. These radicals have intense oxidizing and reducing properties. It might be expected that in dilute solutions or suspensions, such as protoplasm, primary radiation effects are produced mainly in the water solvent. Through the intermediary products so formed, cellular constituents are injured or inactivated.

Consider a very dilute enzyme solution. When the system is irradiated, the water is primarily affected and a certain number of hydrogen and hydroxyl radicals are produced. However, because there are so few enzyme molecules present, it is probably that the activated water radicals will combine with each other and produce very little inactivation of the enzyme. As the enzyme concentration rises, it becomes more probable that the water radicals will combine with the enzyme and a greater degree of inactivation will occur. However, for any specific radiation dose a specific number of water radicals is produced. This number of radicals can inactivate only a specific maximum number of enzyme molecules. Beginning at some concentration of enzyme, no matter how much the enzyme concentration is increased, only a relatively fixed number of enzyme molecules is inactivated by a specific radiation dose.

To generalize about this concept, one can say that for indirect radiation mechanisms, radiation is relatively ineffective in extremely dilute solutions. Over some wide range of concentrations, equal radiation exposures inactivate about the same *number* of molecules (i.e., for increasing concentrations of the solute the *percentage* of inactivated molecules decreases). Finally, if the water solvent is appreciably decreased (as in drying of seeds), radiation effectiveness drops off sharply.

From the above, one can perceive a number of possible methods of minimizing indirect radiation effects. Since peroxides are important radicals, anoxic conditions will tend to have a protective effect by depressing formation of peroxides. Catalases which tend to break down peroxides would also lessen biochemical effects.

But most important, if in the water solvent we could introduce chemical solutes which would combine with the activated radicals and so spare other cellular constituents, true radiation protection might be achieved.

Many studies are being carried out along these lines, using such compounds as the aminoalkylisothioureas and their corresponding mercaptoalkylguanidines. The simplest of these, 5,2-aminoethylisothiouronium·Br·HBr, or AET, can double the dose of radiation needed to kill 50% of a group of mice within 30 days. The main role of these compounds seems to be that of neutralization of the free radicals formed by radiation through the action of their sulfur atoms as electron donors. The resultant mercaptoalkylguanidine free radicals are relatively stable but can react with other radiation-induced free radicals. Thus protection does seem to be possible if agents which are "radical traps" can be provided at the right time and place.

Summary and Preview

To initiate a consideration of the biological effects of radiation, we have reviewed some molecular and biochemical phenomena produced by the interaction of radiation with biological matter. Certain basic general concepts in radiobiology which emerged therefrom have been examined. We shall proceed to a discussion of radiation effects on the cellular level in the next article of this series.

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Correction:

In Part III of this series of reviews (October, 1959, issue, pp. 555-562), the following correction should be made:

Equation 1 should read as follows:

$$\lambda = \frac{\frac{\Delta N}{N}}{\Delta t}$$

OHIO STATE UNIVERSITY SCHOOL OF NURSING
and the
OHIO DEPARTMENT OF HEALTH
announce
A SUMMER WORKSHOP FOR OCCUPATIONAL HEALTH NURSES
August 15 through 19, 1960

The five-day workshop will be held on the University campus at Columbus. Although any occupational health nurse may attend, priority will be given to nurses with two years or less experience in this area of practice. Purpose of the summer session is to improve health services for employees by increasing the occupational health nurse's understanding of some employer problems, her own functions and increasing her ability in performing certain skills. Chief resource consultant will be Mary Louise Brown, assistant professor of Public Health (Occupational Health Nursing), Department of Public Health, Yale University School of Medicine. Other consultants will be from Ohio State University and the Ohio Department of Health.

For further information and application forms, write before July 15 to: Workshop Committee, Ohio State University, School of Nursing, 410 West 10th Ave., Columbus 10, Ohio.

Editorial

Figures and Predictions, Various

THE FIRST months of 1960 have witnessed a flood of reports, analyses, and predictions that are intended to give us a peek at the new decade. Some of these provide raw material for speculation upon what may be in store for the practice of occupational medicine. The trends in four fields may be chosen as having direct bearing upon our specialty: the number and kinds of people in the work force, the changing nature of work itself, the supply of physicians, and certain changes in the nature of medical practice which have already begun. It may be imbecilic to consider these without reference to the full scene of the world's business and politics, but one has to stop somewhere. Barring such mishaps as another war, the holding of a joint convention by the Republicans and Democrats, or the racing of horses backward at the Kentucky Derby, the following meaningful changes are to be expected.

In the first place, there will be more people. The United States is a participant in the current population explosion. In underdeveloped countries this is ascribed to more food and better health. Here, there is some tendency to identify the cause as a greater-than-average ardor in the postwar years, this despite the difficulty of quantifying such things and the hazard of slandering an earlier generation. In any case, there will be many more people in the work force—87,000,000 in 1970 as compared with 73,000,000 today. Within this overall increase, the greatest expansions will occur among both males and females under 25 and among women over 45 years of age. A startling prediction is that "by 1970, nearly one-half of all women aged 35 to 64 will be in the labor force."[1] A large proportion of these will be part-time workers whose principal occupation will continue to be homemaking, the while being industrial itinerants moving to different jobs to suit personal requirements of work hours, travel time, and changing skills. There may be some uncontrolled thought association at this point as one visualizes the age distribution not as a curve but as an hourglass figure—wide at the top and bottom to correspond with the work population bulges, and narrow at the waist to represent a shrinkage in the proportion of 25- to 44-year-old employees.

The nature of work will change rapidly as a result of industrial automation and speed-up of communication. There will be a sharp drop in the employment of unskilled hands as the complicated machines take over the labor of production and service, almost but not quite matched by an increase in the need for highly skilled technicians and mechanics. A byproduct of this will be a substantial reduction in the size of certain large labor unions, a change already well along according to the general business press. An imaginative concept of the table of organization of a large business enterprise of the near future presents, instead of the customary pyramid, a wide-girthed football standing on end. Communications will be so swift and exact as to permit decisions by a decreasing number of persons concentrated near or at the top. The vast majority of employees will be approximate equals at the equator of this figure, and the bottom will represent an irreducible residual of menials whose aggregate wage is too small to justify elimination through mechanization. One could devise a frustrating game whose objective is to fit together the normal distribution curve of intelligence levels, the football-shaped organization table, and the hourglass distribution of workers' ages. One can only hope that practitioners of psychosomatic medicine and industrial psychiatry are getting themselves well braced!

The shortage of physicians in this country has become a matter for serious concern. Medical school faculties are unwilling to enlarge their classes at the price of diminished quality of teaching. We would have to open one new medical school of average size per year just to keep the patient-doctor ratio at its present

value; but there is no sign that this can possibly be accomplished. To compound the problem, there recently has been a marked reduction in the number of qualified applicants for admission to schools of medicine as a result of the attraction of bright young people into other fields of work which offer a better ratio of income to training years. The inescapable result is a doctor shortage that is certain to become intensified over the next decade.

As a result of a continuing growth of medical-care plans, the practicing physician can expect an increasing amount of third-party interest in the services he provides. Whatever one would like to believe about the matter, the fact is that these plans have wide consumer acceptance. People like to pay doctor bills by this indirect means. The payments which once constituted innumerable transactions at the small business level are now concentrated in relatively few offices which handle tremendous sums of money. Large sums of money and formal administration go hand-in-hand. One logical objective of such administration is to prevent loss; and over the next decade we will see an increasing use of unfamiliar yardsticks for the measurement of effectiveness of medical activities, with industry taking the lead in exploring the usefulness of preventive medicine.

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1. Clague, E.: The Changing Nature of the Work Force, presented at the President's Conference on Occupational Safety, Washington, D.C., 1960. (Mr. Clague is Commissioner of Labor Statistics, U. S. Department of Labor.)

Book Reviews

PSYCHIATRY AND THE PUBLIC HEALTH. G. R. Hargreaves. Price, $3.00. Pp. 118. Oxford University Press, 417 5th Ave., New York 16, 1958.

This text is based on the Heath Clark Lectures delivered at the London School of Hygiene and Tropical Medicine in 1957, by the Nuffield Professor of Psychiatry, University of Leeds. It is a brief and readable book which contains interesting observations by a phychiatrist of broad experience.

Chapter 1 "Psychiatry and Its Origin," notes that the earliest explanations of abnormal behavior were based upon theological rather than medical interpretations. Society's attitude towards mental illness has changed, but reactions of fear and pity have been present and "views based on fear all but overwhelmed the voice of pity until the 16th century." By the early part of the 19th century a change had taken place in the popular conception of mental illness; the theme pervading treatment was that of "moral treatment on the insane." At the beginning of the 20th century some specific treatment for some mental illnesses had been developed—for example, the malaria treatment for general paresis — and this led to a more limited approach toward psychiatry, with a loss of the previous general viewpoint. Hargreaves offers the concept that mental hygiene has at least three meanings. These are, firstly, a broad program of hospital reform with more humane treatment of patients; secondly, a sense of well-being—a feeling of being at ease with others; and, thirdly, education in the field of mental illness and attempts at prevention.

In Chapter 2, "Psychiatry in Society," the author astutely observes that "it is because psychiatric disorders affect thought, feeling, judgment, and behavior that they must inevitably have a direct impact on the patient's relationship with others. In this way they differ as radically from other illnesses as does the history of their treatment." The individual's sense of reality is based not only upon his own personality but equally upon the pattern of social values. Society, operating mainly through the family, selects from the various possibilities of the human personality those particular features which should be encouraged and also, in effect, selects other features which are to be inhibited and discouraged.

Chapter 3, "Psychiatry and Medical Administration," deals with mental hospitals and Acts concerning the treatment of patients in these hospitals in Great Britain. The principle of continuity of care during the treatment and rehabilitation of the patient is stressed. This concept of continuity of care, in the opinion of this reviewer, has not received sufficient attention in modern psychiatric thinking. It means that the patient should be treated by the same group of persons throughout the phases of his illness and recovery rather than be shunted from group or agency to another. Admittedly it may be difficult to achieve this in practice but, nevertheless, it should be a goal in planning psychiatric facilities for the community.

Chapter 4, "Psychiatry and the Family Doctor," begins by first outlining some considerations of social psychiatry. We hear a good deal today about stress and its action on the individual, and the author wisely points out "one is tempted to feel that resilience or fragility in the face of psychic stress depends by no means solely on the psychic stamina of the isolated individual, but rather upon the network of mutually interacting emotional relationships within the family." Significantly, the family has shrunk in the past century and a half. The family has not only shrunk in size and in the

width of its ramifications, but the generations have spread apart. "And so the emotional stress that fall on the family now fall on a much smaller group of mutually supporting individuals, of whom children form a much diminished proportion, and in which the age distance between the generations has been much increased." With urbanization and residence based upon class segregation the family has become even more isolated. Furthermore, tradition, and the past, cannot be so readily turned to as a guide because of the changing values of our society. Of interest to the occupational physician is the statement that "industry loses more working time through sickness arising from psychoneurosis than from the common cold." The commonest psychiatric conditions which come within the experience of the family doctor are anxiety state and endogenous depressions, both of which may appear masked as purely physical symptoms. Hargreaves discusses teaching medical students the essential elements of the psychiatric interview and of psychotherapy.

Chapter 5, "Psychiatry and Public Health Practice," relates in part more specifically to Great Britain. The author discusses some of the great triumphs in preventive medicine and cites examples of how psychiatry can contribute.

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PROBLEMS IN THE EVALUATION OF CARCINOGENIC HAZARD FOR THE USE OF FOOD ADDITIVES. Publication 749, National Research Council, Food Protection Committee. Price, $1. Pp. 44. Washington, D. C., Dec., 1959. Available from the National Academy of Sciences, Washington, D. C.

PRINCIPLES AND PROCEDURES FOR EVALUATING THE SAFETY OF FOOD ADDITIVES. Publication 750, National Research Council, Food Protection Committee. Price, not given. P. 9. Washington, D. C., Dec., 1959. Available from the National Academy of Sciences.

These are two publications of unusual timeliness and interest, dealing with the evaluation of the hazards of food additives. Coming from the Food Protection Committee of the National Research Council, they constitute authoritative statements and are vital additions to the reference material of any company or individual concerned with Food and Drug Administration approval of food additives.

The first presents general considerations and principles underlying the evaluation of carcinogenic activity and hazard, which are followed by discussions on the experimental and epidemiological evaluation of the carcinogenicity of food additives and the evaluation of their carcinogenic hazard. Appendices list approximate total quantities of various substances necessary to induce tumors in animals—materials frequently referred to as carcinogens but for which the data are inadequate—and the incidence of spontaneous tumors in the rat and the dog. Also included are tables giving the statistical significance of observed tumors for experimental groups of various sizes.

In the second, and shorter, item, general principles on the use of intentional or incidental additives in foods are briefly discussed and investigations helpful in the evaluation of their safety outlined. The scope of the investigations will depend on circumstances of individual additives. An appendix points out the impracticability of defining a safe dose or an insignificant level in foods that can be applied arbitrarily to all additives.

—R. E. ECKARDT, M.D.
Director of Medical Research Division
Esso Research & Engineering Co.
Linden, N. J.

AFS FOUNDRY NOISE MANUAL. Price, to members of the American Foundrymen's Society, $3.00; to nonmembers, $4.75. Pp. 50, with 66 figures and 11 tables. American Foundrymen's Society, Golf & Wolf Roads, Des Plaines, Ill., 1958.

This manual is divided into nine chapters covering the compensation aspects of loss of hearing, the physics of noise, the physiology of hearing and hearing loss, medical supervision of workers exposed to noise, the measurement of noise, foundry exposures to noise, engineering control of noise, personal protective equipment, and a glossary. It is attractively bound, is printed in easily readable type, and contains many figures and tables. The information contained in this volume is presented in a succinct manner which makes it a valuable addition to the library of the interested nonspecialized person. It should be a great help to the industrial hygienist, the safety engineer, as well as the plant physician and plant manager.

There are a few mistakes which are not serious, but I should like to point out one or two which I feel are important.

In Fig. 14 on page 19, the discrete frequencies used in audiometers are not referred to as "octave bands."

"Acoustic trauma" is not used to describe the hearing loss produced by long-continued exposure to noise. This term is reserved for the hearing loss that is produced by accident, such as blows to the head or explosive injuries. We prefer to use noise-induced hearing loss.

The general term for describing noises with rapidly rising and falling peaks is "impulse" noise rather than "impact" noise. An explosion creates an impulse noise that is not strictly due to impact. An impact noise is always an impulsive type noise, but an impulse noise is not necessarily an impact noise.

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Industrial Medical Association

THE PRESIDENT'S MESSAGE

ROBERT E. ECKARDT, M.D.

OUR INDUSTRIAL MEDICAL ASSOCIATION has just successfully completed its 45th annual meeting, and we are about to embark upon a new year. It is at such times that one takes stock of where we have come from, where we are, and where we are going. It is the time when we, your officers, have the opportunity to meet with the members, learn your complaints and dissatisfactions, weigh them in the light of the over-all picture, and chart our course for the coming year accordingly.

Certainly our organization and, I believe, our special disciplines in the field of medicine and surgery have progressed a long way during the past 10 years. Our membership has increased from 2,150 to 4,000. We have begun, and placed well on the road to success, our own journal. Our special disciplines have been recognized by board certification. Thus we can be proud of the distance we have come in the past 10 years. This progress has been achieved through the foresight and diligent efforts of a host of distinguished men in our field who have served our profession and Association well. To these men we owe a vote of profound gratitude.

Where are we? We are the largest single organization of men and women devoted to the practice of industrial medicine and surgery. Our journal, although successful, needs to be more successful, so that it can be enlarged and made more useful to our membership.

The Occupational Health Institute, as our outgoing president so clearly pointed out, needs to be reactivated so that it can fulfill its avowed functions of certification of industrial health programs, provision of educational opportunities in occupational health, and conduct of research in environmental health. These are the requirements of the immediate present.

Where are we going? Will our membership enlarge to 8,000, 10,000, perhaps 12,000, in the next 10 years? Certainly there is reason to believe that if industry is to be served adequately and intelligently during the next 10 years, this growth potential is there. Will our Journal expand to 100-150 pages of editorial material each month? Will industrial medicine be taught in all medical schools, and will IMA or other fellowships be available for advanced training in this field at most of these schools? Will research funds be available in adequate quantities to support research in preventive medicine, toxicology, epidemiology, diagnosis and treatment, rehabilitation, surgery, legal medicine, and all the other disciplines used every day by the industrial physician and surgeon? Will continuing postgraduate training programs be available to the man in industrial medical practice? If we are to continue our progress during the coming decade, we shall need a continuing flow of dedicated men willing to devote their time and efforts to further progress of our profession and association.

About the turn of the year, I wrote to each district counselor and each committee chairman asking each one to let me know his willingness to continue serving. Also I asked our Journal to publish a coupon for those not now serving who wished to serve during the coming year. The overwhelmingly enthusiastic response assures me that the manpower is there and willing to see us through the coming 10 years. May I urge each of you to continue writing as the year progresses, letting me know what you think is wrong, what you think is right, where you wish to serve. I assure you your voice will not go unheeded. Your ideas and opinions will be carefully weighed, and where your energies can be used, we shall ask you to serve, if not in this year, then perhaps in the years to come.

Abstracts of Current Literature

Mental Health

Troubled People on the Job. American Psychiatric Association, Committee on Occupational Psychiatry, 1959. Distributors: The Mental Health Materials Center, 104 East 25th St., New York, N. Y.

This 29 page pamphlet is prepared for all those people in supervisory positions in industry who, as William Malamud, the President of the American Psychiatric Association, says in the foreword "are perplexed by the problems that people bring to their jobs and who need some guide-lines for helping them to work more effectively." The style is simple, lucid, and very readable.

The first section deals with some facts about emotional illness, and there is an explanation of terms such as "mental illness," "insane," "psychosis," and "neurosis." It is pointed out that "far more important than being able to give a name to a person's symptoms is to know a little bit about how to help a troubled person if his disturbance is not too severe." Next is a brief account of some techniques of helping emotionally disturbed people, with observations on listening and signals of severe disturbance. The third section deals with where to go for expert guidance. It includes a discussion of "breakdown," "supervisor's role," "community facilities," and what to do with a person who does not wish to accept help for his condition.

There is a final section on "Changing the Shop Atmosphere," and "Human Relations at Work." Understanding on the part of a supervisor may smooth over rough moments, and understanding on the part of a worker may do the same when a supervisor is the troubled person. A little humor, a tolerant shrug, and a friendly smile keep many an incident from becoming an issue, for understanding is a two-way street. In conclusion, there are a few pointers on where to go for further help, for family problems, psychiatric problems, and problem drinking. There is also a brief recommended-reading list.

In summary, this pamphlet will be of great value to occupational physicians, not only for its content, but also because it can provide a basis for effective communication and discussion with supervisory and personnel groups, who also should find it interesting reading. —G.C.T.

The Alcoholic Executive. Fortune 61:99 (Jan.) 1960.

This article deals with the alcohol problem among executives and is based on interviews with medical directors of corporations, with executives who have had problems with drinking, and with workers in the field of alcoholism, such as members of the National Council on Alcoholism. Many corporate managements will deny that alcoholism among executives is a serious problem. Medical directors are quoted as stating that there is no great problem in this regard at top managemnt levels, for the executive could not drink heavily and continue to function in his competitive role.

Information from other sources, however, indicates that the picture may not be as satisfactory as the foregoing implies. From outside industry comes testimony of a different sort. This evidence comes from physicians who make a specialty of working with alcoholics, from social workers and others whose job it is to help alcoholics, and from recovered alcoholics themselves. On the basis of their experience, they say that executives are just as susceptible to alcoholism as anyone else, possibly even more susceptible. The drinking pattern becomes established between the ages of 35 and 45, the period when the young executive is moving forward rapidly and also at a time when the executive, if he wishes to drink, has the money and the opportunity available. Interestingly, it is asserted that often a person who becomes alcoholic is often more sensitive and more imaginative and less accepting of routine than his nonalcoholic colleagues. The article goes on to discuss the traditions of drinking in business associated with advertising and journalism. The executive's coverup is described, and there are interesting quotations from executives who previously were alcoholics.

With regard to what the alcoholic can do, reference is made to a few rehabilitation centers, to the National Council of Alcoholism, and to Alcholics Anonymous. What can management do? A company's program should be designed to bring the problem into the open and to change the attitude of employees—all employees—so that alcoholism is viewed not contemptuously but rather as a medical problem requiring medical care. It concludes with a brief description of the du Pont program. —G.C.T.

Healthier than Healthy. K. Menninger.* Think 26:26 (Jan.) 1960. (*The Menninger Foundation, Topeka, Kans.

There are many articles on mental health; this one states four basic principles succinctly.

Mental illness may develop in the lives of any one of us and may develop quite unexpectedly. In fact, all of us have fluctuations in our actual mental health. "This, of course, is not quite like the notion of some physical diseases. One either has cancer or does not have it. One either has malaria or does not have it. The same is true with many other diseases. But in the case of mental illness, it seems that any of us can — indeed, all of us do have some degree of it, at some times, and its severity fluctuates."

Secondly, "the trend of mental illness is usually back toward health, not toward permanent disability and incurability." This view is in contrast to the one frequently held that once a person has a mental illness he is incurable.

The third observation is that the process of recovery is irregular and variable. People with a mental illness may have another attack. Again this view is different from "the old medieval, suspicious, devil-possession attitude toward mental illness." According to the latter, once a person had mental illness, it would remain with him.

The final observation is that sometimes people are in better mental health after having had a mental illness—hence, the title. —G.C.T.

Radiation Health

Environmental Exposure to Uranium Compounds. M. Lippmann.* A.M.A. Arch. Indust. Health 20: 211 (Sept.) 1959. (*Health and Safety Laboratory, U.S. Atomic Energy Commission, 376 Hudson St., New York 14, N. Y.)

During 1950 and 1951, extensive air- and urine-uranium sampling was done in two plants of a uranium refinery, which has since closed. One of the plants handled the "soluble" compounds UO_2F_2 and UF_6, and the other handled the "insoluble" compounds UO_2 and UF_4. Monthly average air dust concentrations were as high as 3,500 μg of "soluble" uranium per cubic meter and 9,700 μg of "insoluble" uranium per cubic meter.

Many urine samples of employees exposed to "soluble" uranium were in the milligram per liter range, but among workers with "insoluble" uranium the highest sample was 108 μg per liter, and most were below 67 μg per liter. The 67-μg figure has been recommended for "insoluble"-uranium workers as a maximum allowable concentration for a "Monday morning" sample, on the basis of 300 mrem per week to the lung and a relative biological effectiveness, (RBE), of 10.

Six workers who had been exposed to "soluble" uranium had to have abnormal urinary findings but not decreased renal function. They were removed from contact with uranium and in a matter of months returned to normal. A few men who worked with "insoluble" uranium and on whom autopsies were performed for nonoccupational reasons were found to have considerably less pulmonary uranium than would have been calculated. —T.S.E.

A Simple Device for Personnel Monitoring of an Accidental Nuclear Reaction. H. F. Henry,* J. C. Bailey, and R. C. Rohr. Nuclear Sc. & Engin. 5:285 (May) 1959. (*Union Carbide Nuclear Company, Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tenn.)

In a location where sufficient fissionable material is handled, the possibility of inadvertant criticality and personnel exposure must be considered. If such occurs, it is desirable to make a rapid distinction between persons significantly exposed to neutrons and those not exposed, in in order that no one needing medical attention be overlooked, that medical facilities not be overburdened with unexposed persons, and that these persons can be reassured about their exposures.

At the Oak Ridge Gaseous Diffusion Plant, a 1-gm indium foil is laminated into each standard security badge. The In^{115} (neutron, gamma) In^{116} reaction makes a slow neutron dose detectable after the event with a standard beta-gamma survey meter. The foil has a 54-minute half-life; an instantaneous exposure of about 60 mrad of neutrons is detectable immediately, and an exposure of about 120 mrad after an hour.

Neutron dose derived from the indium foil may have an uncertainty of the order of factors of about 3 because of differences in relative positions, distances, types of incident, neutron-gamma ratios, etc. Great accuracy, however, is not necessary for this application. The indium-foil badge is simple, cheap, and always available, and it yields results quickly. It has a wide range and is not complicated by accumulating dose over a long period of use. —T.S.E.

An Airborne Radiometric Survey of the Windscale Area, October 19—22nd, 1957. D. Williams,* R. S. Cambray, and S. C. Maskell. Report AERE-R-2890, Electronics Division, UKAEA Research, December, 1957. (*Group, Atomic Energy Research Establishment, Harwell, England.)

On Oct. 10, 1957, an accident occurred at the Windscale No. 1 pile which caused sufficient contamination of the surrounding countryside to make advisable diverting milk produced in the area because of iodine-131 content. An airborne radiometric survey aided in the tracking and delineation of the contamination and had some definite advantages over ground monitoring.

A small airplane which had been used for photography was rapidly converted for monitoring purposes by the removal of self-luminous dials and the installation of sensitive recording-scintillation equipment which could be operated from the craft's 24-volt electrical system. A nominal altitude of 500 ft above the ground was flown. Time limitations prevented the installation of a radio altimeter, which would have made accurate altitude easier to maintain. Radiation levels were recorded continuously, and the original photographic equipment was used to make many concurrent pictures of the ground, thus permitting accurate registration of radiation levels on a map.

Although accuracy and sensitivity were limited by altitude control and lack of a preincident background-radiation flight, the airborne survey demonstrated its usefulness in monitoring a large area rapidly. Ground area could be covered about

25 times faster with this plane than with a surface unit. Other advantages are the freedom from contamination and the ability to fly in areas where ground teams might be limited by terrain or surface conditions, such as snow or ice. —T.S.E.

A Note on Radiation Telangiectases. W. B. Bean.* A.M.A. Arch. Int. Med. 104:622 (Oct.) 1959. (*University Hospitals, State University of Iowa College of Medicine, Iowa City.)

In 1946 a middle-aged woman demonstrated by surgery to have a retroperitoneal giant-follicular lymphoma. In 1947 and 1948 she received a total of 3,720 r of abdominal x-rays for the condition. In 1952 irradiation telangiectases over the lower abdomen were first noted by a physician, and in 1958 a more detailed observation was made. It was noted that, although all telangiectases were confirmed to the irradiated area, they were concentrated selectively in the periumbilical area and in a scar which was 26 years old at the time of irradiation, and not in a scar which was a few months to two years old at the time of irradiation. —T.S.E.

Is a Fluoroscope Useful to the General Practitioner? I. E. Kirsh.* J.A.M.A. 170:1141 (July 4) 1959. (*4801 Church St., Skokie, Ill.)

As measured at the skin, radiation rates of fluoroscopes have been found as high as 118 r per minute and 396 r per examination. These rates are needlessly high and could be substantially reduced by increasing tube-to-table distance, adding filtration, and assuring good dark adaptation of the fluoroscopist. Even with good equipment and technique, however, patient exposure from fluoroscopic examination is many times that of x-ray-film examination.

Fluoroscopic examination is considerably inferior to film examination in detection of detail and density difference. Fluoroscopy should be used in conjunction with appropriate films, not as a substitute, and not at all unless indicated by the possibility of detecting dynamic findings which could not be recorded on film. —T.S.E.

Radioactive Decontamination: A Literature Search. W. E. Bost. U. S. Atomic Energy Commission Report TID-3535, September, 1959. (Available from Office of Technical Services, Department of Commerce, Washington 25, D.C., $1.00.)

Almost all of the 351 references listed are ultimately concerned with health protection. Some are rather more directly related to it, however, such as those on decontamination of skin, bone, clothing, milk and air. —T.S.E.

Ocular Effects of Radiation. D. G. Cogan.* A.M.A. Arch. Indust. Health 20:293 (Oct.) 1959. (*243 Charles St., Boston 14, Mass.)

Several unique anatomic and physiologic characteristics make the eye unusually susceptible to damage by radiant energy. Microwave energy can cause cataracts in experimental animals, although human opacities from this source have never been proved. Shorter wavelengths in the infrared region have long been implicated as the source of cataracts in glass blowers and foundry workers. Short-infrared and visible energy can be focused by the lens and produce retinal burns. Ultraviolet radiation from welders' arcs and the sun may cause a temporarily incapacitating keratitis.

The ionizing radiations comprise perhaps the most urgent forms at present. Effects vary with the nature and energy of the radiation. Soft x-rays can cause a keratitis similar to the welder's "flash," whereas the more penetrating electromagnetic energy causes most concern from a cataractogenic standpoint. The threshold dose of 100- to 200-kv x-rays is about 600 r. Neutrons have from 5 to 10 times the effectiveness when compared on the basis of absorbed dose. Latent period is inversely proportional to dose, from a few months for a high dose to as much as four or five years for a threshold dose. Although cataracts have attracted the most attention, ionizing radiation can cause other ocular effects such as epilation, conjunctival keratinization, corneal ulceration, and lacrimal-gland and mucous-gland atrophy. —T.S.E.

Cs^{137} Biospheric Contamination from Nuclear Weapons Tests. W. H. Langham* and E. C. Anderson. Health Physics 2:30 (July) 1959. (*Los Alamos Scientific Laboratory, University of California, Los Alamos, N. Mex.)

Absorption of cesium-137 (Cs^{137}) in the population occurs primarily by ingestion of foods contaminated by long-range fallout of fission products produced during nuclear weapons tests. It has not been determined whether this occurs by direct contamination of vegetation or by soil integration and plant uptake. The latter route may produce a potential radiation hazard from continued tests about four times as great as by direct contamination.

Cesium levels in the biosphere are expressed as Cs^{137}/g K, since the metabolism of cesium and potassium is similar. The average level in the United States population has increased from about 41 $\mu\mu$c g K in 1956 to about 54 in the first half of 1958. The level in United States milk during 1957 averaged about 32 $\mu\mu$c/g K while the rest of the diet was about 20 $\mu\mu$c/g K. The levels in milk and persons varied significantly with geographic distribution, apparently due to varying meteorological conditions.

The average 30-year Cs^{137} radiation dose, assuming a continuing test rate of 10 megatons of fission per year and uptake via soil integration, is estimated to be about 300 mr, or about 10% of natural background. The average 70-year bone-marrow dose is estimated to be about 500 mr. Assuming

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30-50 r as the genetic doubling dose, indefinite testing at the above rate may produce a 0.5 to 1% increase in the incidence of mutations due to Cs^{137} contamination. It is not possible to estimate the absolute hazard of producing leukemia because of the present inability to establish the dose-range relationship for somatic radiation effects at this exposure level. —G.L.V.

Synergistic Effects of Aerosols: II. Effects on Rate of Clearance from the Lung. C. W. LaBelle and H. Brieger.* A.M.A. Arch. Indus. Health 20: 100 (Aug.) 1959. (*1025 Walnut St., Philadelphia, Pa.)

The rates at which inhaled foreign particulates are cleared from the lungs varied from one hour for metallic iron particles to five and one-fourth month for beryllium sulfate. A portion, but not all, of this variation is due to difference in particle size, large particles, in general, being eliminated more rapidly than small particles. Particles reaching the lungs in very small amounts may be retained in the lung for unexpectedly long periods.

The simultaneous administration of inert dust accelerates the elimination of biologically active particles from the lung when the latter are present in very small amounts. The mechanism by which this is accomplished appears to be that the larger amount of foreign material in the lungs increases the release of phagocytes. Such stimulation might conceivably permit therapeutic decontamination of the lung. —W.D.N.

Implications of Space Radiations in Manned Space Flights. W. H. Langham.* Aerospace Med. 30:6 (June) 1959. (*Los Alamos Scientific Laboratory, Los Alamos, N. Mex.)

Based upon present physical measurements of ionizing radiations in space, two major radiobiologic-problem areas in manned space flight are suggested. These are (1) the biologic effects of densely ionizing primary cosmic-ray particles and (2) the effects of the particulate radiation belts, the Van Allen layers, associated with the earth's magnetic fields. The dose from secondary radiations in the earth's atmosphere at an altitude of about 80,000 feet is only about 100 mrad per week in the northern latitude where it is at a maximum. The primary cosmic particles consist of about 80% protons, 19% alpha particles, and 1% nuclei of elements of atomic numbers greater than 2. Above the earth's atmosphere, the primary cosmic-dose rate drops to about 60 to 70 mrad per week. We have only inferential information regarding the relative biological effectiveness of this radiation, since no accelerators exist which are capable of producing particles in the laboratory analogous to the heavier high-energy components of primary cosmic rays. "It seems unlikely that the existence of a heavy primary cosmic ray problem should be a deterrent to low-orbiting manned space flights of the near future."

The rough estimate of the dose rate in the two Van Allen layers is 10 and 100 rads per hour and the thickness of the belts 2,000 and 4,000 miles respectively. Knowledge is needed about the characteristics of this radiation before the hazard may be evaluated and steps taken to alleviate it. —W.D.N.

Environmental Physiology

Energy Requirements of Men Exposed to Solar Radiation and Heat. R. Shapiro* and C. F. Consolazio. U. S. Army Medical Research & Nutrition Laboratory, U. S. Army Medical Research & Development Command, Report 240, July, 1959. (*1st Lt., MSC, U.S. Army, Fitzsimons Army Hospital, Denver 30, Colo.)

Heretofore it has generally been accepted that caloric requirements of men decrease as environmental temperatures rise above 68°F. Recent studies conducted by one of the authors at Yuma, Ariz., cast doubt on this belief. The present report provides further evidence that caloric requirements increase rather than decrease during exposure either to solar heat or to high ambient temperatures. Ten subjects ate in a regular mess and were allowed water ad libitum. During each phase of the test, however, intake of food and water was carefully assessed. Urinary volume, sweat loss, body temperature, and metabolism during rest and exercise were also measured. To obtain total caloric consumption, the caloric intake as food was corrected for changes in body weight by allowing 6.8 Cal. for each gram of body-weight change.

Caloric consumption per day in each phase was as follows: 78°F indoors, 3,137 Cal; 78°F exposed to sun, 3,794 Cal; and 100.6°F indoors, 3,902 Cal. The latter two are significantly higher than the first.

Energy expenditure during timed exercises was the same in all three phases, and there were no differences in basal metabolism or body temperature. Sweat rate, however, was two and one-half times as great during exposure to sun or high temperatures. The authors conclude that under hot conditions extra calories are utilized by temperature-regulating mechanisms to transport more blood to the skin and to increase sweat production. —D.M.

Diffusion of Water Vapor Through Human Skin in Hot Environment and with Application of Atropine. K. J. K. Buettner* and F. F. Holmes. J. Appl. Physiol. 14: 276 (March) 1959. (*Department of Meteorology and Climatology, University of Washington, Seattle, Wash.)

Water transfer between the skin and the environment occurs by evaporation of sweat, by absorption or desorption from the horny layer,

and by diffusion. In previous papers, the senior author studied water diffusion across human skin by experiments which correct for sweat losses and for changes in water content of the corneum. Diffusion of water displayed osmotic behavior. Thus, when skin is in contact with a liquid medium, water diffuses into the skin when the solute concentration is below 2 M and diffuses outward at greater concentrations. When small areas of skin are exposed to controlled atmospheres at regulated temperatures and vapor pressures, the body loses water by diffusion through the skin to dry atmospheres and gains water by inward diffusion from moist atmospheres. The *neutral relative humidity* in 250 normal subjects had a mean value of 86%. At this humidity, neither gain nor loss of water by diffusion is observed, indicating an equilibrium state.

Diffusion of water vapor is greatly accelerated at high room temperatures under conditions associated with sweating, indicating a lowered resistance of the diffusion barrier in the epidermis. Experiments employing tourniquets and also the local application of atropine seem to indicate that diffusion of vapor through the skin under hot conditions constitutes a substantial fraction of total water loss, sometimes exceeding sweat loss.

Diffusion, as a component of insensible perspiration, is thus not a small constant quantity which can be largely ignored but, instead, represents an important variable whose magnitude and direction depends on a number of environmental and physiological factors. —D.M.

Clinical Toxicology

A Hematological Survey of Industrial Workers with Enzyme-Deficient Erythrocytes. A. Szeinberg,* A. Adam, F. Myers, C. Sheba, and B. Ramot. A.M.A. Arch. Indust. Health 20:510 (Dec.) 1956. (*Government Hospital, Tel Hashomer, Israel.)

Phenylhydrazine, toluene, benzene, trinitrotoluene, naphthalene, aniline, acetanilid, acetophenetidin, sulfonamides, primaquine, pamaquine, para-aminosalicylic acid, methyl chloride, ally propyl disulfide, and other compounds have produced hemolytic reactions. Hemolysis due to sensitivities to various agents has been shown to be related to a hereditary defect in the glutathione metabolism of erythrocytes in certain ethnographic groups. Since many persons in Israel are identified with these groups, the possibility of an increased industrial hazard to these people manifested by hemolysis was considered.

Studies were made of 241 workmen with known exposure to various chemicals in textile-dyeing plants, pharmaceutical factories, munition plants, and a rubber-tire factory to determine (1) whether acute hemolytic reactions occurred and (2) whether signs of mild hemolytic processes could be detected among employees with normal erythrocytes and those with the enzymatic abnormality. The erythrocyte-enzymatic defect was detected in 25 men; no evidence was found, however, of an increased incidence of hemolytic reaction among these workmen. The possibility that hemolytic reactions might occur under other conditions of exposure is discussed. —L.H.M.

Plumbism Following the Use of a Blow-Torch on Paint. J. Dorfman* and M. Davis. Connecticut Med. 23:46 (July) 1959. (*Rocky Hill, Conn.)

This article describes a case of lead poisoning in a 52-year-old house painter. The man became acutely ill shortly after working on a job at which he had burned old thick-layered paint from woodwork, the job being located in an unventilated room. He developed malaise and generalized aches and pains which lasted about two days. After that time, he noted, in addition, weakness of the legs, poor appetite, low back pain radiating to the lower abdomen, and mild diarrhea with the passage of two watery stools daily. On admission to the hospital, the urine lead concentration was found to be 0.30 mg per liter and blood lead concentration 0.14 mg per 100 gm. The man was hospitalized for approximately 25 days and received supportive therapy during that time. In addition, he received small doses of a saturated solution of potassium iodide during the last two weeks of his hospital course. He was discharged free of complaint. —A.D.

Thallium Poisoning: Report of Two Cases. M. D. Stein and M. A. Perlstein* A.M.A. J. Dis. Child. 98:80 (July) 1959. (*4743 N. Drake Ave., Chicago 25)

This report describes two unrelated cases of illness in small children in which the definitive diagnosis of thallium intoxication was made after laboratory determinations of blood and urine thallium concentrations were obtained. Presenting symptomatology in both instances was alopecia, ataxia, and tremor. Blood thallium concentrations were as high as 800 μg% in the first case and 150 μg% in the second case. Urine thallium concentration in the first case was as high as 650μg%. Both patients were treated with dimercaprol and trihexyphenidyl, with good results. No source for the thallium was found in either case. —A.D.

Chronic Cadmium Poisoning. L. Friberg.* A.M.A. Arch. Indust. Health 20:401 (Nov.) 1959. (*Institute of Hygiene, Karolinska Institutet, Department of General Hygiene, National Institute of Public Health, Stockholm, Sweden.)

A brief review of the literature concerning the possible occurrence of chronic poisoning from cadmium is presented initially. The clinical picture, according to the limited number of observations made to date, appears to involve the respiratory system and the urinary tract. Emphysema, anosmia, and small ulcerations of the nasal mucosa have been observed in workers who were exposed to cadmium. Proteinuria, stated to be

the most characteristic general effect, was observed by the author "in about 80% of approximately 40 men with more than eight years of occupational exposure to cadmium." The urinary protein, of low molecular weight, typically does not show the usual precipitation reaction to boiling or picric acid; it is, however, precipitated by 25% nitric acid, 25% trichloroacetic acid, or 3% sulfosalicylic acid. Red and white blood cells have not been present in the urine in most cases. Renal damage has varied from mild changes in the tubules to gross lesions in the tubules and glomeruli. Nephrolithiasis was found in about one-fourth of the workers in the Swedish accumulator industry. Other findings that have been reported are mild anemia, an increase of the sedimentation rate, an increase of the γ-globulin fraction in blood serum, and signs of liver damage. In cases seen by the author, all of the men had been exposed to cadmium for eight or more years. Fatal cases have been described. Removal of persons from the exposure did not appear to affect the course of the disease, presumably because cadmium remains in the body for long periods of time after exposure has occurred. The use of dimercaprol (BAL) or edathamil calcium-disodium enhanced the urinary excretion of cadmium in animals but produced severe renal damage.

Cadmium has been demonstrated in substantial amounts in the kidneys, liver, and thyroid tissue from humans. The author has demonstrated in animals that an exchange takes place between accumulated and newly administered cadmium.

Numerous references are presented to support the contention that chronic cadmium poisoning is a definite clinical entity. —L.H.M.

Methyl Alcohol in Fermented Beverages: Quarterly Report to the Editor on Topics of Current Interest. A. J. Lehman. A. Food & Drug Officials of United States Quart. Bull. 23:171 (Oct.) 1959.

A small quantity of methyl alcohol is generally produced in the fermentation processes in the production of alcoholic beverages. The amount produced is dependent upon the amount of pectinous material present in the fermenting mixture. Thus, higher concentrations of methyl alcohol are found in brandies made from fruits other than grapes.

Methyl alcohol is absorbed rapidly, and absorption may be complete in six hours. It is water-soluble and therefore is distributed in the tissues in accordance with their water content. Some methyl alcohol is eliminated unchanged in the respired air and in the urine, while the remainder is oxidized at a rate much slower than that for ethyl alcohol. The chief metabolite is thought to be formic acid. A time lapse of 12 to 18 hours ordinarily occurs between ingestion and the occurrence of symptoms. The latter usually consist of visual disturbances and symptoms associated with acidosis, which results from the accumulation of formic acid and possibly other organic acids. Damage to the cells of the retina may result in permanent blindness.

The simultaneous administration of ethyl alcohol influences favorably the sequence of events in poisoning from methyl alcohol. The repeated administration of ethyl alcohol in amounts sufficient to maintain a concentration of 100 mg % in the blood has been estimated to be adequate to prevent poisoning from methyl alcohol. Ethyl alcohol has an inhibitory action on the oxidation of methyl alcohol. This action prevents the formation of organic acids and makes possible the elimination of methyl alcohol by other means. Since there is a great preponderance of ethyl alcohol over methyl alcohol in fermented alcoholic beverages, the small amounts of methyl alcohol in the beverages do not constitute hazards to health. —L.H.M.

Surgery

Traumatic Liver Injuries. J. R. Amerson* and H. D. Blair. Am. Surgeon 25:648 (Sept.) 1959. (*Emory University School of Medicine, Atlanta, Ga.)

The authors evaluate the results of therapy of 189 patients from January, 1947, to January, 1958. Reduction in mortality resulting from liver wounds has been accomplished by early diagnosis, adequate whole-blood replacement, the administration of antibiotics, improved anesthesia, and a recognition of the complications resulting from such injuries. Penetrating liver wounds inflicted by knives or ice picks usually are not severe. It is injuries to associated organs that markedly increase complications. Close-range shotgun blasts and crush injuries to the liver represent the severest type of liver damage and have the highest fatality rate. Hemorrhage and its control is the major problem. Necrosis from lack of blood supply, infection, biliary drainage, and secondary hemorrhage are frequently encountered in patients with such injuries after initial surgery.

The treatment of suspected or known liver injury is early exploration, preceded by adequate resuscitative measures. In more than 50% of wounds encountered, active bleeding had ceased when exploration was done. Simple laceration with no active bleeding was treated by adequate drainage only. When bleeding was active, suture of the laceration provided hemostasis. Muscle, omentum, and peritoneum for hemostatic aids have been advocated, and gelatin sponge or foam has been used more frequently, with good results. Missile injury requires only adequate drainage and no extensive debridement, but deep stellate or linear tears require deep approximating hemostatic sutures. Placing drains into such wounds may prevent intrahepatic accumulations of blood, bile, and necrotic substance. Partial or complete

avulsions of large segments require removal at initial exploration; lobectomy or partial resection can be performed, and ligation of exposed large vessels should be accomplished. Abdominal exploration should be complete with liver injuries. With four or five other organs injured, the mortality rapidly reaches 80% to 100%. After repair of injuries, adequate drainage must be established, particularly for bile or pancreatic enzymes. —S.S.

Late Effects of Retained Missile Fragments. G. Strenger* and D. Schwartz. New York S. J. Med. 59:3967 (Nov.) 1959. (*495 E. 18th St., Brooklyn, N. Y.)

The authors studied 123 unselected wounded men who had retained metallic foreign bodies over a six-month period. In 12 cases (9.7%), symptoms were noted which could reasonably be attributed to retention of metallic missile fragments.

Certain criteria were adopted for the determination of disability in this study. These standards were (1) pain if relieved by the removal of the foreign body; (2) spontaneous extrusion of metallic foreign fragments; (3) abscess overlying or surrounding a piece of metal; and (4) a discharging sinus leading directly from a retained missile fragment.

Ten of the twelve men presenting residual effects of retained foreign bodies developed sinuses. All of these men had been wounded by fragmentation missiles. In the 10 men having sinuses, eight of the foreign bodies were imbedded in bone. It is noteworthy that the authors observed no instances of "wandering" from organ to organ. They pointed out that migration might occur if the metallic fragment were sharp or narrow.

It is suggested that a greater effort should be made to remove metal fragments from bone at the time of the original definitive surgical treatment. —J.T.A.

Pressurized Therapy: A New Treatment for Vascular Diseases and Coincidental Low Back Pain. M. E. Eisen.* New York J. Med. 59:3794 (Oct. 15) 1959. (*111 E. 80th St., New York 21, N. Y.)

A new type of pressurized therapeutic garment for specific types of vascular disease and coincidental low back pain has been devised by the author. Seventy-seven patients with specific conditions of low back pain associated with circulatory disease received considerable relief of pain on intensive therapy over a three to six week period. Sixty-eight patients in this group were able to return to their usual occupations.

The majority of the patients studied did not obtain relief of pain with the ordinary type of corset, lumbosacral support, sacroiliac support and other types of appliances.

It is felt that this garment benefits patients by applying air pressure to both thighs and the abdomen, which, in turn, helps to maintain an improved venous return and cardiac output. Eisen emphasizes that muscle ischemia and fibrositis are the principal factors responsible for low back pain. It was his thinking that low back pain may have been relieved coincidentally by improved blood circulation.

Objective tests, including electrocardiograms, venous pressure determinations, and studies of the circulation time corroborated improvement of subjective symptoms. —J.T.A.

Osteo-Arthritis of the Spine. A. Lichtor,* P. Lymberopoulos, and J. Lichtor. Am. J. Surg. 59:683 (Nov.) 1959. (*Division of Orthopedic Surgery and Department of Pathology, Menorab Hospital, Kansas City, Mo.)

Postmortem examination of 54 lumbar spines was carried out to determine the relationship between the presence of osteophytes on the vertebral body, thinning of the intervertebral disk, and arthritis of the posterior apophyseal joint. The thought persists that a bony spur at the edge of a vertebral body is an indication of osteoarthritis. The authors point out that by definition this is untrue. They emphasize that true osteoarthritis occurs only in a diarthrodial joint. In the spine this is found posteriorly between the facets.

The authors emphasized that the primary lesion in osteoarthritis is always in the hyaline cartilage. In more advanced cases, the synovial membrane and joint capsule are involved. The disk space between vertebral bodies is classified as an amphiarthrosis. The finding of spurring at the anterior edge of the vertebral body is associated with tearing of the annulus of soft tissue at its attachment to bone, with hemorrhage and resulting ossification. The authors stress that spurring in this location cannot be termed arthritis either by definition or by pathology.

The findings in the 54 specimens were graded according to Fisher's classification. Grade I: Destruction of superficial cartilage is confined to areas of greatest pressure and movement, with a normal capsule, synovial membrane, and articular contour. Grade II: More extensive destruction of cartilage is found, but this destruction is still confined to pressure and movement areas. Grade III: Total loss of cartilage results in eburnation of bone; osteophytes form at the joint margins; and the capsule undergoes fibrosis. Grade IV: Cartilage is lost completely from the joint surface, with eburnation of exposed bone and remodeling of the bony contour; fibrosis of the capsule and synovial membrane is extensive.

The authors conclude that the osteophytes on the vertebral body, the thinning of the intervertebral disk, and the osteoarthritis of the posterior apophyseal joint had developed independently, and they also emphasize that the presence of osteophytes on the vertebral bodies is not evidence of spinal arthritis. —J.T.A.

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Noise and Hearing

Threshold of Aural Pain to High-Intensity Sound. H. W. Ades,* S. N. Morrill, A. Graybiel and G. C. Tolhurst. Aerospace Med. 30:678 (Sept.) 1959. (*U.S. Naval School of Aviation Medicine, Pensacola, Fla.)

In recent years, many studies on the biologic effects of high-intensity sound have been carried out. These include (1) studies of the damaging effects of sound on the inner ear; (2) studies of the nonacoustic labyrinth; and (3) studies of the production of aural pain by intense sound. This paper compares the thresholds for aural pain in ears having normal hearing sensitivity with those in ears that are nearly or completely insensitive to sound. Data were obtained from 2 normal ears, 8 totally deaf ears, and 10 ears with a very slight residual hearing capability. These ears were exposed by special apparatus, one ear at a time, to tones of varying frequency and of varying intensity for each frequency. The subjects were asked to report (1) the detection of a feeling of some kind in the ear, (2) the presence of discomfort, and (3) the presence of pain. Initially, pain was defined as a sharp, piercing, or burning sensation. After a few experiments, this definition had to be changed to a condition "of extreme or intolerable discomfort." Subjects who were totally deaf reported a sensation of feeling when the sound-pressure level was approximately 127 db and when the frequency ranged between 100 and 700 cps. As the frequency increased above 700 cps, higher sound pressure levels were required to produce a sensation of feeling—reaching a peak level of approximately 140 db at about 2700 cps. Individuals who had a slight remaining hearing capability reported feeling sensation about 10 db below the above values. Normal ears were not tested for this sensation. Individuals with no hearing reported discomfort at about 143 db at 100 cps, and the threshold for this sensation increased slowly to about 145 db at 700 cps; the threshold for this sensation increased steeply for higher frequencies—reaching a peak value of approximately 153 db at approximately 2700 cps. Thresholds for discomfort in subjects having slight residual hearing were somewhat lower than those for the totally deaf for most frequencies, and were about 10 db lower at 700 cps. In ears having normal hearing sensitivity, the thresholds for discomfort were about 10 db below those for totally deaf ears throughout the frequency range. The sensation of pain or intolerable discomfort in totally deaf ears was found to be 150 db at 100 cps and increased to approximately 158 db at 700 cps. For frequencies above 700 cps, this threshold fluctuated slightly about the 150 db level up to a frequency of 3000 cps. The pain thresholds for ears having slight remaining hearing were below, but very close to, those of the totally deaf ears except for the frequency region 300 to 1000 cps. The threshold of pain for normal ears ranged between 145 and 148 db through the frequency range 100 to 1000 cps and then increased to approximately 157 db at 3000 cps. The above values are the averages for the ears in each group. When the total range of sound pressure levels producing pain in all of the ears of the three categories is examined, much overlapping is found The pain threshold for normal ears, however, lies about 10 db below the pain threshold for ears that are totally deaf. From the over-all study, one may conclude that (1) the threshold for aural pain produced by intense sound lies in the range from 140 db up for normal ears and from 150 db up for deaf ears with intact eardrums; (2) the eardrum contains the principal pain-perceptive mechanisms; and (3) aural pain is of no value as a warning mechanism for damage of the ear by intense sound.

—H.O.P.

SAAB Silencer System. N. O. Olesten.* Noise Control Journal 5:15 (July) 1959. (*Rohr Aircraft Corporation, Chula Vista, Calif.)

This paper describes the development of a noise-reducing system for use by the Swedish Air Force. The two basic requirements to be satisfied by the suppressor were (1) the attenuation of noise so that the noise level in a community 1,200 feet from the airplane run-up station would be compatible with residential living, and (2) the attenuation of noise, with the engine operating at military power and with an afterburner, so that the danger of a permanent hearing loss would be removed for ground crew and mechanics working around the airplane. After a preliminary evaluation of the noise source, it was estimated that the noise radiating through the skin of the aircraft would be 34 to 40 db below that radiating from the jet stream and compressor sources of the engine. Therefore the maximum attenuation provided by the suppressor would not need to exceed about 34 db. Developments were carried on, using both model engines and model suppressors, to determine the design details for the full-scale suppressor. These studies with models and the experience with the full-scale suppressor demonstrated three important design features that must be included in a noise suppressor which is to achieve the objectives stated above: (1) an intake suppressor must be used; (2) the exhaust suppressor must be tightly coupled to the aircraft at the exit nozzle of the exhaust-gas stream; (3) if secondary air is used for cooling, the secondary-air inlet must be acoustically treated to prevent radiation of noise. Using the complete full-scale suppressor, overall sound-pressure-level reductions were achieved (at various positions around the aircraft, located 120 feet from the exhaust nozzle) that ranged from 10 db at a position directly in front of the

aircraft to 17 db at a position 135° of arc from the position straight ahead of the aircraft. A test of the noise suppressor without a close-fitting, flexible coupling between the exhaust suppressor and the exhaust nozzle of the aircraft reduced the performance of the suppressor by 8 to 10 db in nearly all measurement positions around the aircraft. These tests clearly demonstrated the need for close coupling, if significant noise reductions are to be achieved. When the exhaust suppressor was used *alone*, the noise reduction decreased by about 5 db at all measurement positions behind the aircraft. At the same time, the noise levels increased, above those without a suppressor, at many positions forward of the aircraft. The effects on the noise levels forward of the aircraft, using an incomplete suppressor assembly, are more clearly demonstrated by octave-band measurements made at a position 30° of arc from the forward projection of the engine-centerline. Here, when using the exhaust silencer alone, the sound-pressure levels were increased (above those when no suppressors were used) by about 5 to 7 db for each of the octave bands, 75-150 cps, 150-300 cps, 300-600 cps, and 600-1200 cps. The use of a complete suppressor—but without a tight, flexible coupling—increased the sound-pressure levels, at this position, in all octave bands except the 37-75 cps band. These increases ranged from about 8 db for the 75-150 cps band to 17 db for the 4800-9600 cps band. These data clearly demonstrate the fact that an effective noise suppressor must include the three above-mentioned important design features. Additional design features and performance data for this particular suppressor are given in the 10 figures accompanying the text. —H.O.P.

Reaction of People to Exterior Aircraft Noise. L. L. Beranek,* K. D. Kryter, and L. N. Miller. Noise Control. 5:23 (Sept.) 1959. (*50 Moulton St., Cambridge, Mass.)

This paper deals with the problem of assessing the responses of residents of communities near airports to noise produced by the operation of aircraft from the airports. The authors have published other papers pertaining to the problem of evaluating responses of community residents. In this paper, they are making another progress report on the methods that may be used for estimating community reaction to noise from flight operations. They point out that each airport and the community surrounding it constitute a special situation. They also state that a full evaluation of community disturbance by aircraft operations requires detailed knowledge of factors such as (1) distance of the nearest populated areas from the ends and sides of runways; (2) type and density of air traffic; (3) runway utilization; (4) operational procedures used; (5) prevailing type of homebuilding construction; (6) socioeconomic status of the communities involved; and (7) motivation and attitude of the residents toward the airport. These factors differ from airport to airport, and the conclusions drawn from one airport and its activities cannot be directly applied to another airport. Yet the authors feel that the annoyance to a neighborhood caused by a change in operations by a specific airport can be estimated. Such an estimation uses a relatively new method of rating *the perceived "noisiness"* of an aircraft noise by means of units called the PNdb. The method also takes into account the statistical nature of the noise produced in a neighborhood by the air operations. Assessment of annoyance in a neighborhood that may be expected to result from a change of operations involves at least the following: (1) "The assignment of a 'perceived noise level,' in PNdb, to aircraft operations over each part of a community." (2) "The comparison of the statistical pattern of the expected perceived noise levels for the new situation with that for some known situation. If the existing annoyance situation for the airport under consideration is already known, the effect of introducing a different type of aircraft, or of preferential runway systems, or of limiting operations to certain heights or times of day or year may be judged." The paper contains extensive, detailed illustrative data which are presented in five tables and seven figures. These data are used to illustrate and explain topics such as (1) computation of perceived-noise levels (PNdb); (2) statistics of aircraft operations over communities; (3) summer vs. winter and vibration vs. noise; (4) daytime vs. nighttime; (5) landings vs. takeoffs and successive days of exposure; (6) extrapolation to new situations; and (7) validation of perceived-noise-level ratings. Finally, the authors discuss the design and use of a special meter to measure perceived-noise levels directly. —H.O.P.

An Experimental Study on the Fundamental Mechanism of Bone Conduction. I. Kirikae.* Acta oto-laryng., Supp. 145, 1959. (*Department of Oto-Rhino-Laryngology, Faculty of Medicine, University of Tokyo, Japan.)

An understanding of the mechanisms by which sound reaches and activates the sensory organs of the ear by passing through bone or tissue is important for (*a*) diagnostic procedures used to evaluate pathological hearing and (*b*) understanding the limits of hearing protection that can be provided by devices that close the usual "air-conduction" paths to the inner ear. This series of investigations makes up a monograph on the subject. Some of the areas considered are theories on fundamental bone-conduction mechanisms; the relations of the structure of the skull, middle ear, and inner ear to bone conduction; vibration patterns of the human skull; vibration of the head and bone-conduction hearing acuity;

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the several mechanisms of bone conduction; and conclusions on the fundamental mechanism of bone conduction. The detailed data are presented in 72 figures and several tables, and a rather extensive bibliography is included. The principal conclusions are (*a*) that three or more mechanisms of bone conduction exist; (b) that, at higher frequencies (above 1000 to 2000 cps), sound waves propagate through the head bones and activate the sensory organs by altering the size of the cochlear partitions; (*c*) that, at lower frequencies (below 1000 cps), the differential movements of the middle ear structures and the skull bones activate the cochlear organs in the same way that normal "air-conducted" sound does; (*d*) that, also at low frequencies, relative motion between the contents of the cochlea and the bony cochlear structure may activate the end organs; and (e) that two or more of these mechanisms may be active at the same time for sound frequencies above 1500 cps. —H.O.P.

Experimental Toxicology

Protection by Sulfur Compounds Against Air Pollutants Ozone and Nitrogen Dioxide. E. J. Fairchild II,* S. D. Murphy, and H. E. Stockinger. Science 130:861 (Oct. 2) 1959. (*Occupational Health Program, U.S. Public Health Service, Cincinnati, Ohio.)

Mechanisms of defense against the lethal effects on mice of air pollutants ozone and nitrogen dioxide are discussed. Two distinct but related pathways of protection are shown by simultaneous inhalation of compounds that furnish –SH or –SS–, or both, and by injection of thiourea derivatives several days prior to exposure to the oxidant gases. The mechanism of the first pathway is believed similar to that proposed for the action of radiation-protective compounds. The mechanism of the second involves the development of a tolerance initiated against the oxidants by the thiourea. —R.E.E.

The Toxicological Basis of Threshold Limit Values: 5. The Experimental Inhalation of Vapor Mixtures by Rats, with Notes upon the Relationship between Single Dose Inhalation and Single Dose Oral Data. U. C. Pozzani,* C. S. Weil, and C. P. Carpenter. Am. Indust. Hyg. A. J. 20:364 (Oct.) 1959. (*Mellon Institute, Pittsburgh, Pa.)

"The components of 15 commercial chemical mixtures and 36 pairs of chemicals did not in any case act in a markedly less or markedly more than additive manner by the respiratory route. This was also true for 15 commercial mixtures and 23 chemical pairs tested orally." Finney's method for predicting the LC_{50} values of vapor mixtures from values of individual components is discussed. "The highest correlations were found between the predicted and observed inhalation values. However, lower but still significant correlations between observed oral and observed inhalation values suggest that a single-dose-inhalation LC_{50} value can be predicted from oral data with a fair amount of reliability. Although the prediction formula is theoretically suitable only for similar joint action, it provides a fairly accurate method for predicting the single dose toxicity of mixtures from single dose toxicity data on their components." —R.E.E.

A Study of the Sensitivity of the Mouse Forestomach Toward Certain Polycyclic Hydrocarbons. F. G. Bock* and D. W. King. J. Nat. Cancer Inst. 23:833 (Oct.) 1959. (*Roswell Park Memorial Institute Biological Station, Springville, N. Y.)

Three groups of C57BL mice were painted once with about 0.1 ml of a 1.5% solution of 7,12-dimethylbenz(a)anthracene (DMBA). One group then received 0.1 ml of crude cigarette-tar concentrate in acetone twice weekly; the two other groups were painted with acetone alone or received no further treatment. For control purposes, two groups were pretreated once with benzene instead of DMBA. Significant changes, i.e., skin tumors and forestomach papillomas and lymphomas, occurred only in those animals pretreated with DMBA. The forestomach papillomas may have resulted because the animals licked the material from the skin. Additional animals were given, by intragastric intubation, 0.5 mg DMBA, benzanthracene (BA), or methylcholanthrene (MC) in mineral oil. Both single and repeated doses at intervals of three to seven days were given. Forestomach papillomas were induced in 2 of 27 animals after total doses of 4 or 8 mg BA; one dose of 0.5 mg of DMBA or MC caused gastric papillomas in 11/13 and 8/14 of the respective groups. Repeated doses totaling 4 to 8 mg caused forestomach papillomas in all 54 animals tested and carcinomas in 6. No tumors were induced in controls given 0.1 ml of "heavy mineral oil," 1, 8, or 16 times. The high sensitivity of the mouse forestomach to single doses suggests its use for testing weakly carcinogenic compounds. —R.E.E.

Hypertension Due to Inhaled Submicron Amorphous Silica. G. W. H. Schepers.* Toxicol. & Appl. Pharmacol. 1:487 (Sept.) 1959. (*E. I. du Pont de Nemours & Company, Wilmington, Del.)

Cardiac pressure elevations were provoked in rabbits by inhalation of synthetic amorphous silica, eight hours a day five days a week for up to 27 months. Particle size was in the 200 A range. The magnitude of the response was proportional to the dose administered, the rate of exposure, and the duration of inhalation. The elevations were partly reversible on cessation of exposure. Studies during life revealed concomitant radiographic changes, electrocardiographic deviations, modifications of lung functions, and hemato-

logic and electrolyte disturbances. At autopsy, anatomical cor pulmonale, congestive cardiac failure, emphysema, and chemical pneumonitis were established as the main responses to amorphous silica dust inhalation. Not all types of amorphous silica induced these changes, and 12 varieties, in fact, induced little or no change. Precise physicochemical characteristics are believed to determine the nature of the hazard associated with amorphous silica dusts. —R.E.E.

Data for the Determination of the Maximum Permissible Concentration of Hydrogen Chloride Aerosols in the Atmospheric Air. E. V. Elfimova. Gigiena i Sanit. 24:13 (Jan.) 1959; Air Pollution Control A. Abst. 5:4 (#2611) (Sept.) 1959.

The olfactory-threshold concentration of HCl for man is about 0.1-0.2 mg/cu m. The reflex-threshold values in mg/cu m are as follows: optic chronaxy, 0.6; light sensitivity of eyes adapted to darkness, 0.2; vascular reaction, 0.5; and respiration, 0.1-0.2. A maximum permissible concentration of 0.05 mg/cu m is recommended. —R.E.E.

Effect of Chlorpromazine on Cyanide Intoxication. S. Levine* and M. Klein. Proc. Soc. Exper. Biol. & Med. 102:192 (Oct.) 1959. (*St. Francis Hospital, Jersy City, N. J.)

Hydrogen cyanide intoxication is effectively antagonized by chlorpromazine pretreatment in mice when hypothermia normally induced by the drug is allowed to proceed. The protective effect is largely lost when normal body temperatures are maintained. Pretreatment of rats with chlorpromazine is ineffective against slow, protracted HCN exposures. —R.E.E.

The Toxicity of Boron Oxide. J. J. Wilding,* W. J. Smith II, P. Yevich, M. E. Sicks, S. G. Ryan, and C. L. Punte. Am. Indust. Hyg. A. J. 20:284 (Aug.) 1959. (*U. S. Army Chemical Warfare Laboratories, Army Chemical Center, Md.)

No toxic signs or evidence of internal organ damage were seen in rats exposed to aerosols of boron oxide for up to 24 weeks, the highest concentration being 470 mg/cu meter for 10 weeks, or in dogs exposed to 57 mg/cu meter for 23 weeks. The mass median diameter of particles ranged from 1.9 to 2.4 μ. Chemical analyses of dog blood and rat blood and urine showed no significant differences over control values except for an increased urinary excretion of creatinine in rats, lower pH, increased volume, and increased boron content of rat urine. No changes were found in fragility and roentgenograms of rat bones, hematology of dog blood, and sulfobromophthalein retention. Rats refused to drink water containing 1.0% or 1.5% boron oxide and therefore lost weight over a period of 25 days. Intragastric intubation of a 10% slurry of boron oxide into rats over a three-week period did not retard growth or cause any other noticeable effect. Application of boron oxide dust to the clipped backs of rabbits produced erythema that persisted for two to three days, and almost immediate conjunctivitis resulted when the dust was applied to the eyes. These were, no doubt, brought about by the exothermic reaction of hydration to boric acid. —R.E.E.

Skin Grafting in the Study of Cocarcinogenesis. P. N. Cowen.* Brit. J. Cancer 13:228 (June) 1959. (*London Hospital Medical College, London, England.)

Data from skin-painting and -grafting studies suggest that the state of initiation and the genetically controlled degree of susceptibility to skin-tumor induction (by initiation followed by promotion) are properties inherent in the skin, since they are transferable by whole-thickness grafting and are unaffected by previous treatment or generic status of the host. —R.E.E.

Studies on the Toxicology of Aurin Tricarboxylic Acid. W. L. Downs.* and others. Nuclear Sc. Abstr. 13:2012 (Sept. 15) 1959. (*University of Rochester, Rochester, N. Y.)

The acute toxicity of aurin tricarboxylic acid (ATA) is relatively low—0.48 to 3.0 gm/kg, depending on species and route used—when administered to rats, rabbits, or mice. When ATA was given to mice intravenously one hour after an intravenous injection of beryllium, a marked reduction in deaths was observed. Rats exposed to high ATA-vapor concentrations for up to 20 hours showed no toxic effects. Repeated daily intraperitoneal injections in rats of 30 mg/kg or more resulted in some blood changes. No toxic effects were seen in rats after a six-month feeding period of diets containing up to 1% ATA; dietary levels of 3% or 5% ATA caused blood changes without affecting growth or causing tissue injury. Rats fed a diet containing 10% ATA for 49 days failed to grow. Moderate to severe kidney injury was observed in dogs given 2 or 20 mg/kg ATA on alternate days for one year. —R.E.E.

A Study of Vitamin B_{12} Protection in Experimental Liver Injury to the Rat by Carbon Tetrachloride. D. K. Kasbekar,* W. V. Lavate, D. V. Rege, and A. Sreenivasan. Biochem. J. 72:384 (July) 1959. (*University of Bombay, Bombay, India.)

The effects of CCl_4 poisoning and the protection afforded by vitamin B_{12} when given before CCl_4 dosing were studied in rats. CCl_4 appears to provoke a loss of B_{12} from liver and its particulate fractions. A simultaneous impairment in the metabolism of liver sulfhydryl compounds is observed. These changes are followed by a depletion of liver RNA (ribonucleic acid), phospholipids, and proteins, and an accumulation of fat. Methionine levels are unaffected; liver glycogen depletion is pronounced and lasting and is apparently

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not protected against by B_{12}. Vitamin B_{12} protection is nonspecific and may be due to an effect on the maintenance of mitochondrial integrity.
—R.E.E.

Internal Medicine

Epidemiologic and Clinical Observations in Sarcoidosis. M. M. Cummings,* E. Dunner, and J. H. Williams Jr. Ann. Int. Med. 50:879 (April) 1959. (*Director, Research Service, VA Central Office, Washington 25, D.C.)

A diagnosis of sarcoidosis was made on 1,700 patients in Veterans Administration hospitals between 1949 and 1956. A critical review of 1,194 case records was made. The most striking observation was the geographic distribution in the eastern United States where pine forests are located. Pine pollen contains certain chemical fractions similar to fractions of the tubercle bacillus. It also contains a phosphatide, which when injected intradermally or intraperitoneally in rabbits and guinea pigs provokes an epithelioid and giant-cell response.

From the 1,194 case records, 175 were chosen for further study because they were biopsy-confirmed. Several interesting observations resulted. The lungs and hilar lymph nodes showed involvement in 97%. Eye involvement occurred more frequently in Negroes. The most frequent symptom was a nonproductive cough, followed by weight loss, dyspnea, fatigue, chest pain, and visual disturbances, in that order of frequency.

The laboratory results showed that Hyperglobulinemia occurred most frequently (88%), and, in order of decreasing frequency, was followed by hypercalcemia, increased alkaline phosphatose, leukopenia, and eosinophilia.

The most frequent cause of death was cor pulmonale. Active tuberculosis was a significant finding in nonwhite patients. Tuberculosis, Hodgkin's disease, and carcinomatosis were the diseases most frequently confused with sarcoidosis. —S.H.S.

Work and Heart Disease: II. A Physiologic Study in a Steel Mill. A. B. Ford,* H. K. Hellerstein, and D. J. Turell. Circulation 20:537 (Oct.) 1959. (*Department of Medicine, School of Medicine, Western Reserve University Hospitals of Cleveland)

Fifty-three workers in a steel mill were studied at their usual assignments throughout a typical work shift. In addition to measurements of pulse rate and blood pressure, oxygen consumption was measured in expired air and energy expenditure calculated according to Weir's formula. Environmental temperatures were measured by standard industrial hygiene techniques from which heat stress was calculated. The group included 20 subjects with heart disease, 12 with arteriosclerotic heart disease, 7 with hypertensive cardiovascular disease and 1 with severe tachycardia. Fourteen control subjects were engaged in the same jobs as the cardiac workers, and nineteen other normals were engaged in other typical steel mill jobs.

Slightly higher pulse rates were noted in cardiac workers than in their controls, but only in occasional instances were these differences significant. Both resting and exercise blood pressure values were higher in cardiac subjects. Twenty per cent of the cardiac subjects developed borderline or abnormal electrocardiographic changes, compared with six per cent of the noncardiac group. There was no essential difference in the energy expenditure of the cardiac group when compared to the control groups.

The conclusions are that many jobs in a steel mill are satisfactorily performed by workers with recognized heart disease. Although certain jobs may elicit abnormal physiologic responses in these workers, and in a few normals, there was no evidence that these changes were actually harmful to those who experienced them. —J.J.T.

Interventricular Septal Defect Secondary to Nonpenetrating Injury. N. E. Crow,* and B. G. Brogdon. A.M.A. Arch. Int. Med. 103:791 (May) 1959. (*Department of Radiology, USAF Hospital, Lackland Air Force Base, Texas)

A truck wheel passed over the thorax of a 13-year-old boy with only apparent minor injury. X-ray examination of the chest was said to reveal "pulmonary contusion" and normal cardiac size, and configuration. The onset of progressive dyspnea and edema one month later was associated with physical signs of cardiomegaly as well as a loud systolic murmur and a palpable thrill. The cardiac insufficiency did not yield to usual therapeutic efforts. Surgical intervention some six months later revealed three ventricular septal defects near the apex. These were surrounded by scar tissue, and complete closure of all defects was not possible.
—L.W.

Factors Influencing the Course and Prognosis of Systemic Lupus Erythematosus. R. P. McComps,* and J. F. Patterson. New England J. Med. 250:1195 (June 11) 1959. (*Professor of Graduate Medicine, Tufts University School of Medicine, Boston)

Systemic lupus erythematosus until recently was considered a progressive, fatal disease; it is now known that spontaneous remissions may occur in about one-third of the cases.

Seventy-seven cases were analyzed at the New England Center Hospital. The following impressions evolved:

1. The disease is less frequent in males, but the prognosis is poor.

2. The younger the patient, the graver the prognosis. Conversely, when the diagnosis was established after the age of forty-five, the more favorable the prognosis.

3. Renal involvement, even when the urinary findings were mild, such as persistent albuminuria and

hematuria (only a faint trace of albumin at first and 3 to 5 red blood cells) were of serious prognostic import.

4. Corticosteroid therapy did not improve renal function; it may, however, prevent renal disease, and apparently will not cause it.

5. Polyserositis, manifested by pleural effusion, pericarditis, or peritonitis responded to steroid therapy if renal involvement was not present. The same applies to myocarditis and encephalitis.

6. Hemolytic anemia and thrombocytopenia occurring late in the disease was usually associated with other serious manifestations, and the prognosis was poor.

7. In some cases, the precipitating factor appeared to be pregnancy, but, if pregnancy occurred in the course of the disease and no renal involvement was present, a normal delivery and a normal baby could be expected.

8. In treated patients, death was due to renal involvement or the complications of steroid therapy.

—S.H.S.

Plasma Catechol Amine Concentrations in Myocardial Infarction and Angina Pectoris. P. C. Gazes,* J. A. Richardson, and E. F. Woods. Circulation 19:657 (May) 1959. (*Department of Pharmacology and Therapeutics, Medical College of South Carolina, Charleston)

Plasma catecholamines (norepinephrine and epinephrine) were determined fluorometrically in normal persons, patients with recent myocardial infarction, patients with angina pectoris, and a small group with noncardiac chest pain. Norepinephrine levels were significantly increased in 13 patients with myocardial infarction compared with 7 normal persons and 6 with noncardiac pain. Seven of the eight with myocardial infarction also showed elevated epinephrine levels. Eight of twelve patients with angina pectoris showed elevated norepinephrine levels after exercise, compared with seven normal persons.

The increased plasma concentrations of norepinephrine and epinephrine are probably liberated from the myocardium and coronary vessels as well as the adrenal medullar in these diseased states. Their presence may explain the relationship of angina to factors such as exposure to cold, heavy meals, and tobacco smoking which cause increased sympathetic nervous discharge. The onset of arrhythmias in acute myocardial infarction and angina pectoris may also be due to the action of these substances on the myocardium. In addition to the beneficial effects of rest and the avoidance of situations producing sympathetic nervous activity, this demonstration suggests that other methods which interfere with the production of catecholamines or block their action may have therapeutic application. Sympatholytic drugs and members of the reserpine group are two likely possibilities which should have further study.

—J.J.T.

Iproniazid in Angina Pectoris. M. Shoshkes,* E. L. Rothfeld, M. C. Becker, A. Finkelstein, C. C. Smith, and F. W. Wachtel. Circulation 20:17 (July) 1959. (*Cardiac Clinic of the Beth Israel Hospital, Newark, N.J.)

Twenty-three patients with proven angina pectoris were given iproniazid by means of a "double blind" technique. The drug was effective in relieving pain in 64% and 73% of the group on two separate periods, while the placebos were effective in only 30% in two separate periods. Iproniazid at the dosage level used also produced a mild hypotensive effect and an elevation of mood and aided in maintaining body weight. There was no change in the clinical course or progression of the primary heart disease.

Doses above 50 mg per day should be used only initially and not in ambulatory patients. Once a therapeutic response occurs, the dose should be lowered stepwise at one- or two-week intervals until the minimum effective dose is found for the individual patient.

NOTE: In the same issue of *Circulation*, E. R. Jolly, M.D., of the New Drug Branch, Department of Health, Education and Welfare, comments editorially on the hazards associated with this drug. The occurrence of hepatitis, severe hypertensive reactions, psychiatric changes and evidence of pronounced autonomic nervous stimulation even at dosage levels of 50 mgm. per day has been observed. For these reasons, iproniazid should probably only be used in patients with severe intractable angina and then only under the direction of physicians familiar with the drug.

—J.J.T.

Benign Hypertension. Albert A. Pollack,* and James R. Gudger. A.M.A. Arch. Inter. Med. 103:758 (May) 1959. (*The Mutual Life Insurance Company of New York, 1740 Broadway, New York 19)

Life insurance policyholders required to pay increased premium rates because of elevated blood pressure (above 136 mm Hg systolic and 88 mm Hg diastolic) alone—i.e. without other causes for increased premium rates—were the subject of this study. It is assumed that the blood pressure was measured with the individual in a sitting position and that the reported reading represents the average of two or more readings. Data on persons with severe degrees of hypertension are not included in this study, since such cases are not insurable. Some 2,510 policy files compiled between 1942 and 1954 were reviewed.

A significant reduction in life expectancy occurred in the 40-year age group when the diastolic level was 90 mm or more. Such reduction was not observed among the older policyholders. In both groups, however, increasing systolic pressure was associated with a gradual slight decrease in life expectancy, roughly proportional to the pressure increase. It is concluded that occasional elevated readings are significant and should be included with normal ones in efforts to evaluate life expectancy among

otherwise healthy persons. It is emphasized that elevations are less significant when first noted among older persons. —L.W.

Interpretation of Symptoms with a Data-Processing Machine. K. Brodman,* A. J. van Woerkom, A. J. Erdmann Jr., and L. S. Goldstein. A.M.A. Arch. Int. Med. 103:776 (May) 1959. (*68 E. 86th St., New York 28)

Answers given by 5,929 consecutive adult white patients to the Cornell Medical Index Health Questionnaire and the diagnoses established by this and other means during hospital or clinic care were subjected to study, a high speed electronic data-processing system being used. Taking into consideration these data, plus the age and sex of the patient, the machine derived a measure of the probability that a specific complaint might be related to a given diagnosis. Thus an average score of symptoms or complaints was established for each of a number of disease states.

The value of these data was tested by using the answers recorded by another 2,745 consecutive adult white patients on the Cornell Medical Index Health questionnaire.

The machine correctly identified the presence of 1 of the 60 most frequently encountered diseases in 44% of the cases—at the rate of one patient per second. A physician reviewing a large sample of these questionnaires without other medical information did a little less well but was twice as astute as the machine in recognizing psychoneuroses (81% vs. 42%). —L.W.

Medical Care Administration

Why We signed A Union Agreement. M. Cherkasky.* Mod. Hosp. 93:69 (July) 1959. (*Director, Montefiore Hospital, New York.)

In March, 1959, Montefiore Hospital signed a union agreement with local 1199, Retail Drug Employees Union AFL-CIO. This agreement covered more than 600 persons classified as non-professional. The basic condition which brought the hospital to the attention of the union was the low wage scale of most of the hospital workers. Other conditions of employment such as sick leave, vacation time, holiday time, and other benefits were all comparable to those of industry.

During 1958 an operating deficit of approximately $1,300,000 was incurred at Montefiore Hospital. The deficit incurred by care provided city and tuberculosis patients was close to $1,000,000, and Blue Cross patients produced a loss of more than $250,000. The hospital was faced with the situation where they were seriously short of funds and unable to meet simultaneously both their primary duty of providing medical care, and that of adequately compensating the workers.

For many months the hospital resisted the effort of the union to force collective bargaining because (1) there was no method by which funds could be provided to cover wage increases, and (2) those responsible were concerned about the effect of organization upon already difficult hospital operations.

The city agreed to provide a $4 increase for medical and surgical cases. After many heated, lengthy sessions, a union contract was agreed upon. It is obvious that hospitals are going to have to pay workers an adequate wage. The public should realize that increased hospital costs resulting in increased hospital rates are the results of the enormous complexities of medicine. —A.B.

Hospital Utilization Under Insurance. M. I. Roemer.* Hospitals 33:36 (Sept. 16) 1959. (*Director of Research, Sloan Institute of Hospital Administration, Cornell University, Ithaca, N. Y.)

Charges have come from many sources that the rate of hospital utilization is unnecessarily high, and that insurance has led to abuses. Muckraking articles would lead one to believe that unreasonable demands by patients are largely responsible for the high and rising cost of hospital care insurance.

Factors determining hospital-utilization rates are numerous and complex. A day of hospital care depends upon the convergence of three determining forces: the patient, the hospital, and the physician. Those factors involving the patient include (1) incidence and prevalence of illness, (2) attitude of people toward illness, (3) cost of medical care to patient; (4) marital and family status, and (5) housing and social level.

Factors involving the hospital include (1) the supply of hospital beds (given insurance, available beds tend to be used), (2) the efficiency of bed utilization, (3) the financing of hospital costs, (4) the availability of alternative bed facilities, and (5) the out-patient departments.

Factors involving the physician include (1) the supply of physicians, (2) the method of medical remuneration, (3) the nature of community medical practice, (4) the medical policies in the hospital, (5) the level of medical alertness, (6) and the medical teaching needs .

Within each of these factors are forces at play which drive the hospital-utilization rate upward, while other forces drive it downward. The level of hospital utilization which is "proper" or "reasonable" for the United States is ultimately a question of social values—how we wish to spend our economic resources. Given widespread insurance, the basic determinant is probably supply and distribution of hospital beds. —A.B.

The Role of Organized Labor in Occupational Health. W. A. Sawyer.* Indust. Med. & Surg. 28:329 (July) 1959. (*Medical Consultant, International Association of Machinists, Washington, D. C.)

For the most part, organized labor does not consider its role in occupational health to be particularly significant, since in-plant services are exclusively instituted and managed by the employer. Labor regards itself as the recipient rather than the participant. Labor feels that such programs are primarily for the benefit of employers—to save money on workmen's compensation costs. It is often inclined to mistrust the medical opinions expressed by the company doctor. Since most occupational health services are found in large industry and the majority of workers are employed in small plants, only a small percentage of workers have the benefits of such programs.

Extensions of the scope of in-plant service to cover nonoccupational sickness and accidents are receiving more and more thought. Labor's chief goal seems to be comprehensive medical care on a group, prepaid basis.

There is increasing concern for the health of the whole man, and there is also concern for the health of his family. Industrial physicians cannot ignore absence due to sickness and accident of a nonoccupational nature. If management is paying any part of the cost of nonoccupational illness or accidents, it should be increasingly concerned about the effectiveness of the benefits provided. There is a growing belief that the over-all health of the worker should not be arbitrarily and inefficiently divided as it now is.

Outstanding examples of comprehensive medical service sponsored by industry come to mind —Endicott-Johnson Company, serving more than 17,000 employees and their dependents, and Consolidated Edison, under the Employees Mutual Aid Society, Inc., with more than 30 hospitals and 400 physicians cooperating.

American workers are demanding good health at a price they can pay. American industry wants a healthy working force functioning at its most productive level.

American medicine is showing an increasing interest in the health of industrial workers and in union-health plans. —A.B.

Disability—Cash Benefits Versus Rehabilitation. Medical Care Section and Committee on Medical Care Administration of the American Public Health Association. Am. J. Pub. Health. 49:1082 (Aug.) 1959.

Acceptance of social responsibility to provide for disabled persons (outside of institutions) has grown rapidly in the United States during the last few decades. It has taken the form principally of cash benefits—lump sum, temporary, or permanent payments. More recently, attention has been turning to programs whose objective is restoring in the individual the ability to provide for himself. These programs include special education and training opportunities, sheltered employment, and in recent years, medical rehabilitation.

Abstracts

It is regrettable that forces which should be complementing one another tend toward conflict. Thus far, cash benefits have received the greatest emphasis; in this program it is necessary to establish criteria of disability as a basis of eligibility. Disability is regarded as relatively fixed. A claimant has to demonstrate his disability against efforts to belittle it by those seeking to hold down the cost of compensation.

Cash benefits cannot replace the need for rehabilitation. Wherever possible, the disabled worker should be restored to his full place in society rather than left to live on a limited invalidity pension. Every system dealing with disability should encourage rehabilitation and make it as widely available as possible. Safeguards are needed so that the worker is not taken advantage of through his own efforts to rehabilitate himself. Rehabilitation services must be made generally available. There must be recognition that rehabilitation and cash benefits do not necessarily conflict. It must be recognized that disabled persons deserve, as a social right, access to rehabilitation services. Our social security structure should assure all disabled persons decent income maintenance for themselves and their families. Rehabilitation cannot proceed on the quicksands of inadequate income. —A.B.

The Challenge of the Small Plant. A. J. Hayes.* Indust. Med. & Surg. 28:317 (July) 1959. (*President, International Association of Machinists, Washington, D. C.)

So far as medical knowledge is concerned, we have it within our power to make drastic reductions in the toll of occupational disease. Dr. Harold Magnuson noted that less than 1 out of 10 of all employees have health services available to them: most of those who have work in large industry. The problem, then, is in small plants, which employ approximately two-thirds of the labor force.

The problem of providing occupational health service to employees in small plants is a complicated one and will vary from industry to industry and from community to community. The primary responsibility lies with the employer, but the worker has a definite stake in occupational safety and health because, after all, it is the worker whose life, limb, and health is involved. The attack upon problems of occupational health must be a concentrated one with the whole community contributing to the full extent of its health resources. Because of the high cost and necessary shortcomings of individual small plant programs, we can make the greatest possible progress through the development and expansion of cooperative community programs and union health centers. This is the purpose of the Health Service Facilities Bill of 1959.

The Bill would provide Federal loans to voluntary nonprofit, prepaid, health service programs. It

faces opposition of powerful groups. The enactment of a Federal occupational compensation law would give all industry a financial stake in the prevention of occupational illness. Such a step would place before industry in general the knowledge and the facilities in the field of occupational health services which are all too often now used solely by the giants in industry to cut down their own costs with little or no regard at all for conditions in industry or society in general. —A.B.

Dermatology

Chemical Burns. G. K. Lewis.* Am. J. Surg. 98: 928 (Dec.) 1959. (*Departments of Surgery, Illinois Central and Cook County Hospitals, Chicago, Ill.)

Misuse of, or accidental contact with, chemicals causes approximately 3,300 deaths a year, and many thousands of nonfatal burns. The chief difference beteen a chemical burn and a thermal burn is that the destructive process caused by the chemical continues until its effect is neutralized. In addition to local action, some chemicals produce systemic evidence of injury, as liver or kidney damage. In burns from mineral acids and alkalis, the common factor for injury is the H or OH concentration. However, corrosion may also depend upon coagulation, precipitation, dehydration, or actual solution of protein. Acids produce coagulation necrosis, which is immediately apparent, whereas alkalis produce effects that are often insidious.

Oxalic acid has a local irritant action on the skin and mucous membrane. It may produce hypocalcemia by removal of calcium ions and may also damage the kidney where the acid is concentrated and excreted. Hydrofluoric acid is highly corrosive and continues to destroy tissue until the acid has been removed or neutralized. Intense local vasoconstriction at the site of contact may lead to ischemic necrosis. Phenol burns may not be felt immediately because the phenol is also a local anesthetic. It can be absorbed through the skin and appear in the urine, which becomes smoky in color. Chromic acid produces characteristic lesions known as "chrome holes," which are usually painless. Acetic acid is one of the strongest organic acids and penetrates the the tissues readily, causing dermatitis and ulcers. Formic acid produces blisters on the skin which tend to spread, even after exposure ceases.

Corrosive effects of the group of alkaloidal reagents are caused by ability of the anion to direct chemical precipitation of protein via the anion. Examples are trichloroacetic, tungstic, picric, sulfosalicylic, phosphomolybdic, and tannic acids.

The special problems of burns from war gases and other chemicals used in warfare are discussed.

Emergency treatment of chemical burns consists of irrigation or dilution and neutralization of the causative agent. In burns from simple solvents, irrigation for 10 minutes is usually adequate, but burns from acids and alkalis should be irrigated for a half-hour or more, and burns from hydrofluoric acid should be irrigated for 3 to 12 hours. Neutralizing a chemical before it has been thoroughly diluted may be harmful. The heat generated in the neutralization process may in itself cause a burn. In an acid burn, a neutralizing agent of weak alkali, such as a solution of sodium bicarbonate is indicated. In an alkali burn, dilute acid, such as 1% solution of citric acid is used. After neutralization, the injured area should again be irrigated. Subsequent management of chemical burns is similar to that of thermal burns.

Care of chemical burns of the eyes takes priority over all else. Copious irrigation with water, keeping the eyelids open, is the first step. To avoid synechia of the iris, it is important to keep the pupils dilated. Attention by an ophthalmologist should be provided as soon as possible. —D.J.B.

The World's Most Costly Itch. Occup. Hazards 22: 23 (Jan.) 1960.

According to a recent survey by the Association of American Soap and Glycerine Producers, Inc., 26% of manufacturing workers face daily exposure to skin irritants and 9% of these actually contract some form of dermatitis resulting in lost time. The annual cost to industry of occupational skin diseases is estimated at $100,000,000 annually.

Personal and plant cleanliness are effective means of preventing the world's most costly itch. A good rule of thumb to follow is that no worker should have to go farther than 100 feet to reach running hot and cold water, a good skin cleaner, and clean towels. A continuing program of cleanliness education is necessary in some plants.

Barrier creams and ointments are helpful in preventing dermatitis, but they must be used properly. They may be classified as vanishing creams, which leave soap in the pores and help remove irritants when washing; water-repellents, whose film of lanolin or silicone repels water-soluble irritants; and solvent-repellents, which protect against irritation from solvents and greases.

Ideally, new production processes should be investigated for possible cutaneous hazards, and protection should be built into the process.—D.J.B.

About the Authors

Born in Chicago, DR. KENNETH J. MUNDEN is a graduate of the St. George College, Weybridge, England, in 1938, and of the School of Medicine of the University of Madrid in 1946. From 1946 to 1950 he practiced internal medicine in Madrid and was on the staff of a university hospital there, meanwhile serving as editor of the Journal *Medicamenta*. From 1951 to 1952 he interned at St. Luke's Hospital in Chicago and then entered the five-year residency program of the Menninger School of Psychiatry in Topeka, Kan., serving three years as a resident at Topeka State Hospital and for two years on the staff of Larned State Hospital.

His interest in industrial health problems stems from work with the mining industry, small plants, and craftsmen in Europe. In addition, his family has long been associated with the International Harvester Company, for which his father has been an overseas manager since 1923. DR. MUNDEN'S professional memberships include the American Psychiatric Association, the Kansas Psychiatric Society, and the Mid-Continent Psychiatric Association.

DR. HARRY LEVINSON is a native of Port Jervis, N. Y. He was graduated from the Kansas State Teachers College of Emporia in 1943. After two and a half years of military service, he received his master's degree at Emporia State and later his Ph.D. in clinical psychology from the University of Kansas.

DR. LEVINSON was closely identified with the movement which brought about the nationally recognized improvement of the Kansas state hospital system. From June 1, 1950, to Dec. 31, 1953, he was coordinator of professional education at the Topeka State Hospital, concerned with the development of programs for training professional personnel. He also served as the hospital's liaison with the legislature and developed the hospital's public relations program. He is coauthor of "Human Understanding in Industry," is editor of "Toward Understanding Man" and has written several pamphlets and many articles on mental health.

On Jan. 1, 1954, DR. LEVINSON was appointed to the Menninger Foundation staff, to undertake a study of the extent and expression of emotional maladjustment in industry. An outgrowth of that study is the Menninger Foundation's Division of Industrial Mental Health, which was organized in 1955 under a three-year grant of $105,000 from the Rockefeller Brother Fund. He is now the director of that Division.

DR. LEVINSON is a member of the American Psychological Association, the Kansas Academy of Science, the American Association for the Advancement of Science, and President of the Kansas Psychological Association. In November, 1954, he was given a distinguished service citation for public education in mental health by the Topeka Chapter of Hadassah.

L. HOLLAND WHITNEY, M.D., has contributed Part III of the panel, Dilemmas of the Occupational Physician in Mental Health Programming, presented at the April, 1959, meeting of the Industrial Medical Association.

DR. WHITNEY is Medical Director of the American Telephone and Telegraph Company, at that firm's general headquarters in New York. His association with the telephone company began in 1948, when he was appointed medical director of New Jersey Bell Telephone Company. His move to the central organization of the telephone system occurred in 1955.

DR. WHITNEY is a native of New York State. He holds A.B. and M.D. degrees from Syracuse University (1924 and 1928, respectively). He

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About the Authors

interned at Brooklyn Hospital and served a residency in pediatrics at Bellevue Hospital. He practiced pediatrics in Brooklyn from 1930 to 1942, and concurrently served the Sperry Gyroscope Company as medical director on a part-time basis. In 1942 he became medical director on a full-time basis with the Sperry company. In 1946 he was appointed Director of Health and Safety of the American Home Products Corporation, which position he held until he joined New Jersey Bell.

DR. WHITNEY is a member of Alpha Omega Alpha honorary fraternity, a specialist certified in Occupational Medicine by the American Board of Preventive Medicine, and a director of the Industrial Medical Association.

MACROY GASQUE, M.D., is senior author of the article, "The 'How' of an Industrial Gynecologic Survey," based on work done at the medical department of Ecusta Paper Division of the Olin Mathieson Chemical Corporation at Pisgah Forest. DR. GASQUE is a native of North Carolina and was educated at the University of Tennessee and the University of Virginia. Although his formal clinical training was in surgery, one suspects on the basis of his list of publications that his interest is shifting to the opportunities for prevention inherent in industrial practice. He is prominently identified with the field of occupational medicine in the new industrial south. He was recently chairman of the Section in Industrial Medicine and Surgery of the Southern Medical Association, and is a lecturer on industrial medicine at both Duke University and Bowman Gray School of Medicine. He is a member of the Industrial Medical Association and is certified by examination in Occupational Medicine by the American Board of Preventive Medicine. Associated with DR. GASQUE in the presentation of his article are DR. PLUMB, and MISS DEBORD.

CARL S. PLUMB, M.D., served in the Royal Canadian Air Force during World War II. He accomplished his education at the University of Toronto, graduating with the M.D. degree in 1952. He then headed south. After an internship at Orange Memorial Hospital, in Orlando, Fla., he served a residency in surgery at the Lewis-Gale Hospital in Roanoke, Va. He thereafter became associated with DR. GASQUE at Pisgah Forest. He recently made a tentative move northward, to get a year of training in the occupational health program at Yale University, from which institution he received the M.P.H. degree.

MARGARET ANNE DEBORD, R.N., was graduated with a B.S. degree from the Emory University School of Nursing in 1953. Soon thereafter, she began work in the industrial medical department of Olin Mathieson Chemical Corporation at Pisgah Forest, N. C. She has taken a leading role in developing the gynecologic survey work in the de-

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partment with which she is associated. She is active in industrial nursing affairs, being a member of regional and national industrial nursing associations.

M. LAURENS ROWE, M.D., is author of the topical review in this issue, "Newer Concepts of Low Back Pain." After receiving the B.A. degree from Colgate University in 1938, he attended Harvard Medical School, from which he received the M.D. degree in 1941. There followed a year of internship at the Cincinnati General Hospital, a short period of active service in the U.S. Navy, 10 months of residency training in orthopedic surgery at the Mayo Clinic, and two more years (1943-1945) of residency in orthopedic surgery at the Cincinnati General Hospital.

DR. ROWE entered the practice of orthopedic surgery in Rochester, N.Y., in 1945, and has since that time held various appointments in that city. He became a consultant in orthopedic surgery to Eastman Kodak Company in 1953; he was appointed Chief of Orthopedic Surgery at the Rochester General Hospital in 1956, and is now Chairman of the Medical Board of that institution; and he is Clinical Assistant Professor of Orthopedic Surgery at the University of Rochester. DR. ROWE was certified by the American Board of Orthopaedic Surgery in 1948 and became a Fellow of the American Academy of Orthopaedic Surgeons in 1951.

ALBERT A. SPRITZER, M.D., M.P.H., is Assistant Clinical Professor of Occupational Medicine at the University of Pittsburgh and part-time Medical Director of Westinghouse Reactor Evaluation Center, Waltz Mills, Pennsylvania. He is an assistant in medicine on the staff of the Western Pennsylvania Hospital, where he has charge of the pulmonary function laboratory; and he is on the staff in medicine at the Presbyterian Hospital, Pittsburgh.

DR. SPRITZER graduated in chemistry from Wooster (Ohio) College, where he was elected to Phi Beta Kappa honorary fraternity. He received the M.D. degree from Albany (New York) Medical College in 1952. After a year of internship in medicine he served two years of residency in that specialty in the New York University Division of Bellevue Hospital, New York, N. Y. Thereafter he spent two years in study and research at the Department of Occupational Health, the University of Pittsburgh's Graduate School of Public Health. He was chief resident in medicine at Western Pennsylvania Hospital in 1958-1959.

DR. SPRITZER is senior author of the article in this issue, "Biological Effects of Radiation at the Molecular Level," the fourth in the series of topical reviews in radiation health coming from the University of Pittsburgh. He was a co-author of an earlier article, "Bronchogenic Carcinoma from Radioactive Cerium Fluoride," published elsewhere.

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People and Events

Richard J. Krebsbach, M.D.

► RICHARD J. KREBSBACH, M.D., has been appointed Medical Director and chief of the medical group for Norair Division of Northrop Corporation in Hawthorne, Calif. He succeeds ROGER D. MACKEY, M.D., who has retired.

DR. KREBSBACH received his education at the University of Minnesota, obtaining the B.A. degree in 1950, B.S. degree in 1952, and M.D. degree in 1954. He interned at the Veterans Administration Hospital in Long Beach, Calif., and did postgraduate work in dermatology at the same institution. In 1956, he joined Norair as supervisor of medical services. He is a member of Alpha Omega Alpha, the Industrial Medical Association and the Aerospace Medical Association.

DR. MACKEY received his medical degree from the University of Virginia in 1918. From 1924 until 1950, he was a staff member of several naval hospitals, and hospitals in Chelsea, Mass., and San Diego, Calif. He became full-time Medical Director of Northrop Aircraft, Inc., in 1950. He is a Fellow of the American College of Physicians, a Diplomate of the American Board of Internal Medicine, and a member of the American College of Hospital Administrators, and the Airlines Medical Directors Association.

► GORDON W. RICHMOND, M.D., has been appointed Chief Medical Adviser to the Iranian Oil Operating Companies with headquarters in Teheran.

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Gordon W. Richmond, M.D.

DR. RICHMOND received his M.D. degree in 1938 from Stanford University School of Medicine, and served his internship at Alemeda County Hospital. From 1941 to 1943 he was Chief Surgeon for the Marinship Corp., Sausalito, Calif., and in 1946 became Refinery Physician for the Richmond Refinery of the Standard Oil Company of California.

From 1953 to 1955 he served as a Major in the U.S. Army Medical Corps and was assigned to Aberdeen Proving Ground, Maryland, as Post Industrial Medical Officer and Preventive Medical Officer. After completing his army service he was loaned by the Standard Oil Company of California to the Iranian Oil Exploration and Producing Company as principal medical adviser in the oil fields.

DR. RICHMOND is a member of the Industrial Medical Association, the International Hospital Federation and the Persian Gulf Medical Association.

► GILBEART H. COLLINGS, JR., M.D., has been named Medical Director of Standard Oil Company (Indiana), succeeding BRYCE B. REEVE, M.D., who has retired. DR. COLLINGS has been Associate Medical Director since last June. He came to Standard from the Crane Company, Chicago, where he had been Medical Director since 1957. Prior to this he held positions as a specialist in occupational medicine with Bethlehem Steel Company and the Tennessee Valley Authority. He also served with the U.S. Army Medical Corps at the Army Environmental Health Laboratory, Army Chemical Center, Md.

DR. COLLINGS received his M.D. degree from Emory University School of Medicine, Atlanta, Ga., in 1941, and took graduate work in occupational medicine at Johns Hopkins University, earning a master's degree in public health with a major in industrial medicine. He is a Fellow of the Industrial Medical Association, American Public Health Association and American Academy of Occupational Medicine, and a member of the American College of Preventive Medicine, Medical Director's Club of Chicago, and the national Medical Directors' Forum. He is certified in occupational medicine by the American Board of Preventive Medicine.

DR. REEVE received his M.D. degree from Indiana University School of Medicine in 1921, and served his internship at Passavant Memorial Hospital in Chicago. He practiced surgery in Arkansas for a year before joining Standard in 1923 as a physician in its Whiting, Ind., refinery first-aid hospital. He became Medical Director in 1934.

DR. REEVE is one of the charter members of the Medical Advisory Committee of the American Petroleum Institute, and was honored by the API last October with a Certificate of Appreciation. He is a member of the Medical Advisory Committee of the National Safety Council and also received a Certificate of Appreciation from NSC last year. He is a Fellow of the Industrial Medical Association, and a member of American College of Preventive Medicine, the Medical Directors' Club of Chicago, and the national Medical Directors' Forum. He is certified in occupational medicine by the American Board of Preventive Medicine.

► MARVIN R. ALBERG, M.D., has been appointed Chief Physician in charge of the general office medical department of Standard Oil Company (Indiana). He joined the company in 1954 as physician at the Whiting, Ind., refinery and was transferred to the medical department in the general office at Chicago in 1959.

DR. ALBERG received his A.B. degree from the University of Denver in 1944 and his M.D. degree from the University of Colorado School

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People and Events

of Medicine in 1947. He did postgraduate work at the University of Michigan and earned the Master of Public Health degree in 1954. He is a lieutenant commander in the United States Navy (active reserve) and served with the U.S. Naval Hospital in Oakland, Calif., from 1951 to 1953. He is a member of the Industrial Medical Association and the American Industrial Hygiene Association.

► EARLE T. DEWEY, M.D., has been appointed Medical Director of the Metropolitan Life Insurance Company's Pacific coast head office. He has been Assistant Medical Director of the Pacific office since 1946.

DR. DEWEY attended the University of Minnesota and obtained his M.D. degree in 1928. He interned at San Francisco City and County Hospital. He is a Fellow of the Industrial Medical Association and a member of the American Public Health Association.

►CARL T. OLSON, M.D., 66, died on April 1 in St. Petersburg, Fla. From 1946 until his retirement in 1956, he was Medical Director of the Loss Prevention Department, Liberty Mutual Insurance Company. DR. OLSON was a general surgeon in Breckenridge, Minn., for 19 years before entering industrial medicine in 1939 when he became Medical Director for the Fansteel Metallurgical Corporation in Chicago. He received his M.D. degree from Rush Medical College in 1919, and interned at Cook County Hospital in Chicago. He was a Fellow of the Industrial Medical Association and served for many years on its Workmen's Compensation Committee.

► The name of the Council on Industrial Health of the American Medical Association has been formally changed to the Council on Occupational Health. This was approved by the AMA Board of Trustees at a meeting on February 5, 1960. There has been no change in the membership of the Council. B. DIXON HOLLAND, M.D., continues as Secretary, with HOWARD SCHULZ as Assistant Secretary.

► N. GILLMOR LONG, M.D., Medical Director, Lumbermens Mutual Casualty Company, has been appointed co-chairman of the Committee on Surgical Practices, International Association on Occupational Health. He was also recently elected chairman of the Section on Surgery of Trauma of the International College of Surgeons.

► Texas Industrial Medical Association held its annual meeting April 10 at the Hilton Hotel in Ft. Worth. At the business meeting, the following officers and board members were elected: President—NOBLE B. DANIEL, M.D.; President-Elect—ROBERT A. WISE, M.D.; Vice-President—CARL A. NAU, M.D.; Secretary-Treasurer—J. G. BURDICK, M.D.; members of the Board of Directors—MAX E. JOHNSON, M.D., E. E. BADEN, M.D., VALIANT C. BAIRD, M.D., ROBERT J. POTTS, M.D., and FRANK W. WILSON, M.D.

► The First annual meeting of the Kentucky Industrial Medical Association was held April 7 at the International Business Machines Corporation in Lexington, Ky. The meeting, which began in the afternoon, included a dinner session and an evening session. Scientific discussions presented were as follows: "General Discussion of Industrial Dermatology" by RAYMOND R. SUSKIND, M.D., Kettering Laboratory, University of Cincinnati School of Medicine; "Practical Environmen-

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tal Control of Industrial Dermatitis" by H. W. LAWRENCE, M.D., Medical Director, Procter and Gamble Company; "Mental Health in Industry" by A. A. MCLEAN, M.D., Psychiatric Consultant, International Business Machines Corp. D. JOHN LAUER, M.D., Medical Director of Jones and Laughlin Steel Corp., was the dinner speaker.

► New England Industrial Medical Association will hold its spring meeting in conjunction with the Massachusetts Medical Society on May 18 at the Hotel Statler Hilton in Boston. CARTER ROWE, M.D., orthopedic surgeon, Harvard Medical School, will address the luncheon meeting on the subject, "The Orthopedic Examination of the Injured Back."

► Industrial Medical Association of New Jersey elected the following officers at a meeting on March 18: President—FRANK DE GRACE, M.D.; Vice-President—THOMAS NEVINS, M.D.; Treasurer—ANGELO CALABRESE, M.D.; Secretary—M. R. VASCHAK, M.D.

► The American Board of Health Physics, which was established last October by the Health Physics Society, has set up the procedures by which it will certify radiation protection experts throughout the United States.

A candidate for certification in Health Physics must have a bachelor's degree in science or engineering and at least five years experience in a position of responsibility in the radiation protection field. He must be capable of making a complete radiation protection study of several types of radiation installations and will normally be asked to submit reports of typical examples of his work. A written examination, will normally be required but may be waived for especially well qualified persons who apply before December 31, 1960. An oral examination also may be required in addition to the written examination.

The American Board of Health Physics is composed of five members, all nominated by the Health Physics Society. Other organizations will be asked to nominate additional members in the near future. Present members of the Board are ELDA E. ANDERSON, J. W. HEALY, J. S. LAUGHLIN, W. A. MCADAMS, and L. S. TAYLOR, MR. MCADAMS is Chairman of the Board.

The examinations, both written and oral, will be conducted by an Examination Panel which is still to be selected. Membership in the Health Physics Society is not required for certification, nor for membership on the Board or on the Examination Panel. It is expected that the first certificates of certification will be issued about July 1, 1960. Application blanks for certification may be obtained from DR. ELDA E. ANDERSON, Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. An application fee of $15 must be paid when the application is submitted to the Board and will not be returned if the applicant fails to qualify. An additional fee of $10 will be charged when certification is approved.

Association Activities

The following actions taken by the Board of Directors of the Industrial Medical Association at the meeting on February 10, 1960, are in addition to those reported in the April, 1960, issue of this journal (pages 18a and 20a).

The Board—

Received report of Committee on Standards to effect that the medical services of four companies were approved for certification, one was deferred and six survey reports are under study.

Adopted a policy that appointments to committees of the American Standards Association should generally be that appointments are made for the life of the committee or for the life of the appointee, unless he wants to be relieved of the assignment or unless he is impotent in the assignment.

Agreed to accept the invitation to meet with the Council on Industrial Health, American Medical Association, in Charlotte, North Carolina in October, 1960.

Received report on prospective new component societies from DR. ROWNTREE. The Rocky Mountain Academy of Industrial Medicine is well organized and expects to petition for component society status in the fall of 1960. The Puerto Rico IMA has submitted its proposed By-Laws. Director EMMETT B. LAMB, M.D., plans to visit Puerto Rico in March and discuss their organization with them. Western Ohio members are planning a component society. There has also been correspondence with reference to Florida, Cuba, and the Philippine Islands.

Received progress report on the XIIIth International Congress on Occupational Health to be held at the Waldorf Astoria Hotel, New York City, July 25-29, 1960, from ROBERT E. ECKARDT, M.D., Secretary-General. Estimated attendance is 1,000 from foreign countries, approximately 1,500 from the United States.

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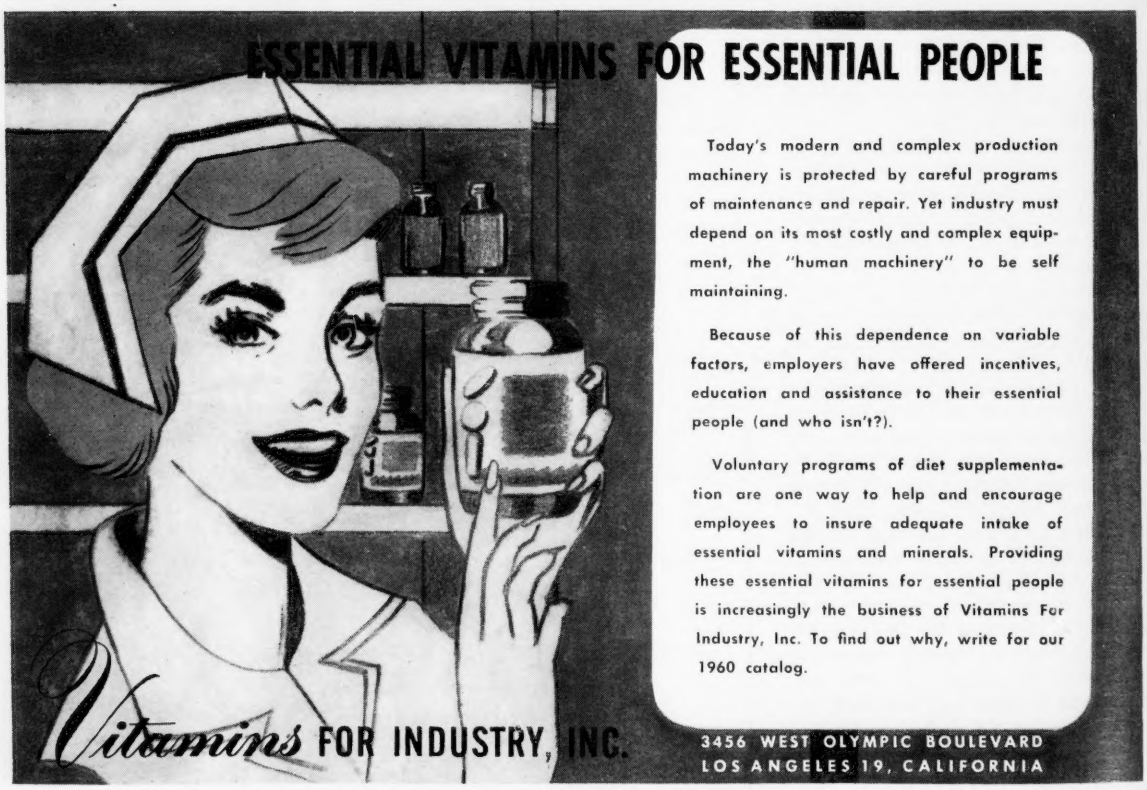
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